July 1976

A special issue dealing with America's immediate future

Smithsonian

A look into our third century

The communications industry has hardware that can revolutionize our lives (p. 78)

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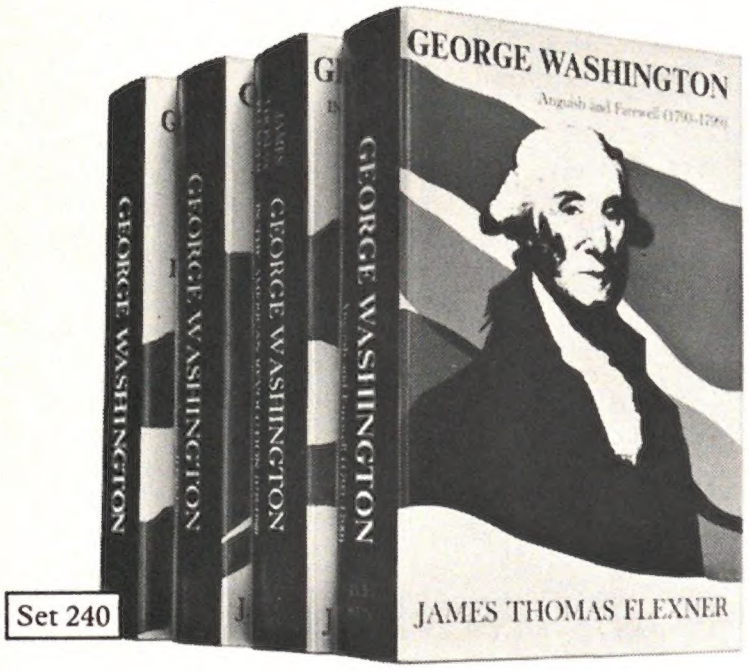

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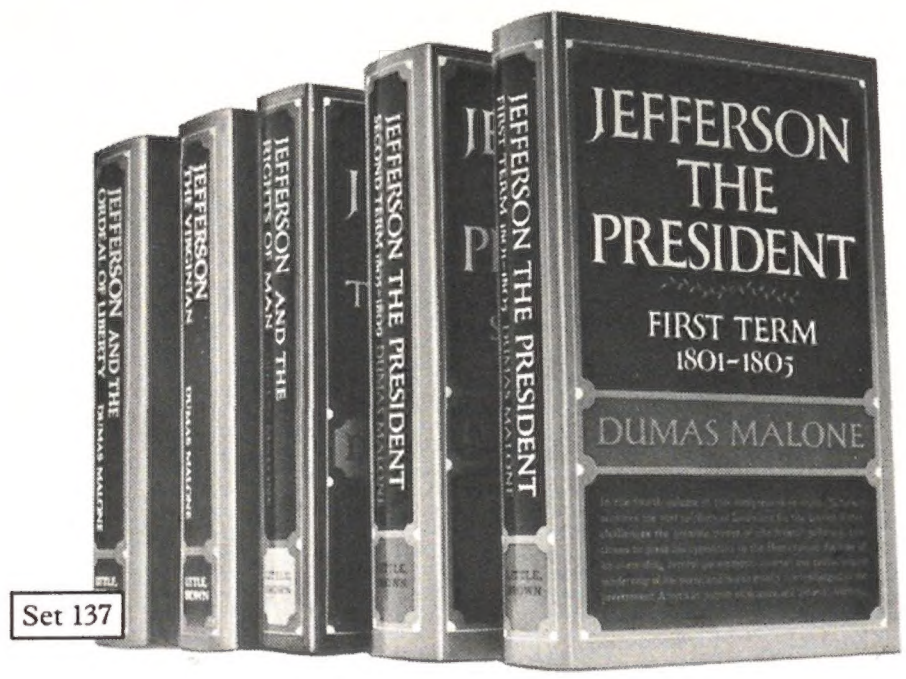

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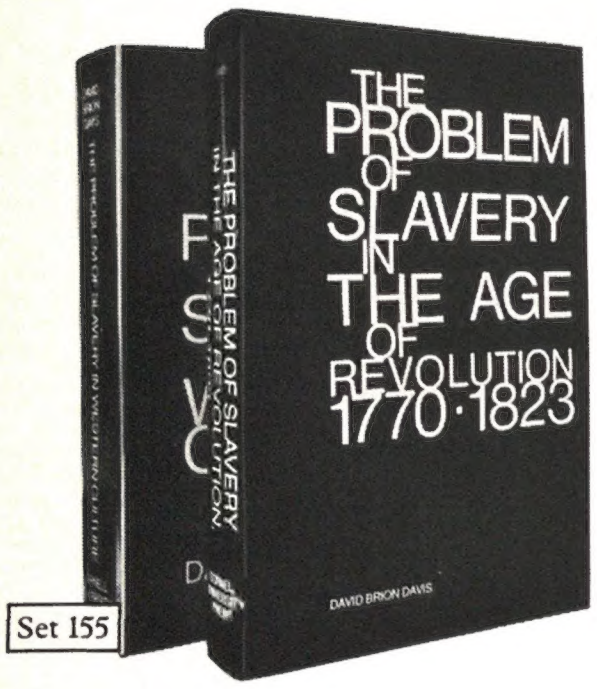

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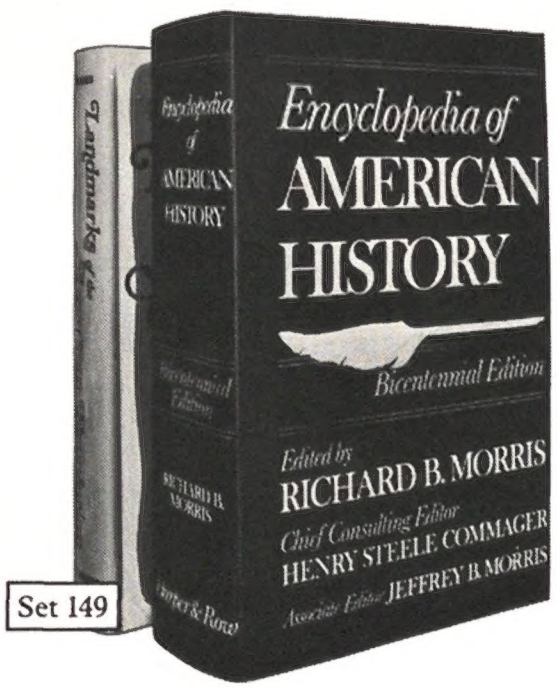

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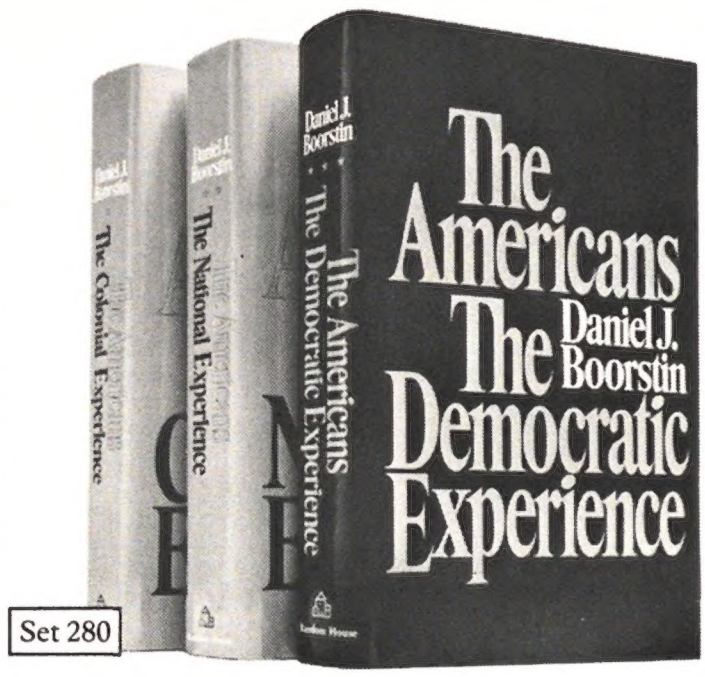

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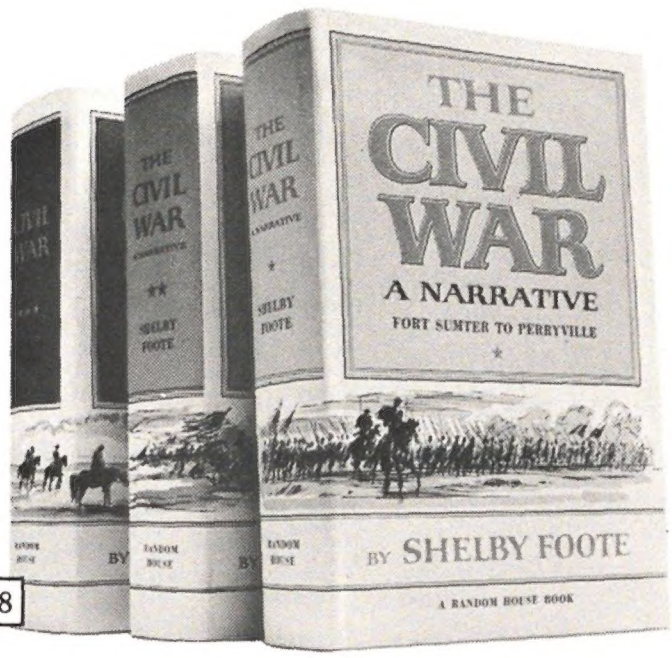

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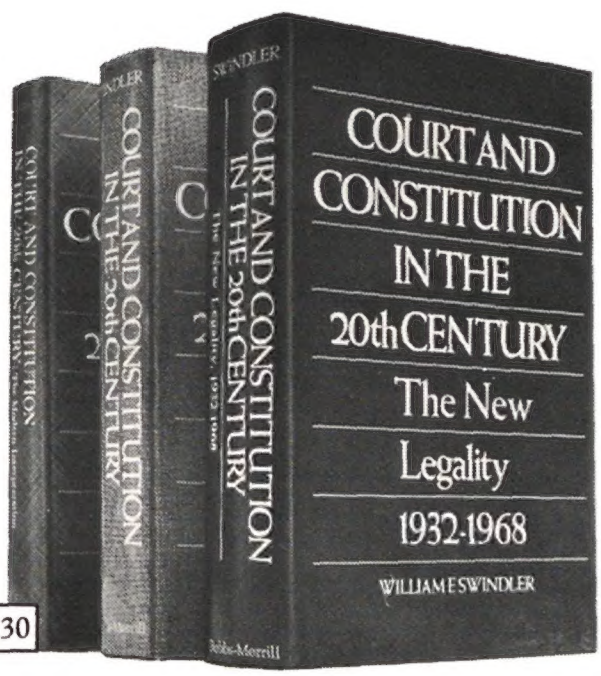

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Secretary Ripley's comments

The view from the castle

History proves that there are no snug harbors;
Americans, sometimes cynical, should
face the future with humor and optimism

This is July, not just any July but *the* 200th. My own feeling is that it is the month to look forward, not back, and this special issue of SMITHSONIAN shows that the editors share this view. I believe we should contemplate the future with ease and good humor.

If this nation has managed so far, it is not because we have now reached a snug harbor and can drop anchor, safe from stormy seas. History makes a mockery of that. But if we look forward, let us do it with confidence supported by a steady view, with equanimity and not anxiety. That is why I speak of ease and good humor.

We gain nothing by deploring the past, wallowing in our failures of leadership or the evidence of venality and corruption that continue to be flaunted in our daily ration of the news. As Thomas Jefferson wrote (in 1807), "I really look with commiseration over the great body of my fellow citizens who, reading newspapers, live and die in the belief that they have known something of what has been passing in the world in their time; whereas, the accounts they have read in newspapers are just as true a history of any other period of the world as of the present, except that the real names of the day are affixed to their fables."

Americans enjoy being cynical, especially about government, and they tend to assume, sometimes with an undercurrent of piousness, that corruption—at least for some—is here to stay. But Americans have enormous resilience. When one considers the state of our country 200—nay 100—years ago, the distance that we have traversed is stupendous. Poverty, disease, lack of communication and transportation—today, compared with the past, we are at a level of security and technological knowledge never before equaled.

We should take great heart in all this liberation from drudgery and pain, as Philip Abelson recently editorialized in *Science*. And in taking heart, we must retain our sense of balance and face ahead. In this I find museums a wonderful comfort. In a nutshell, in a microcosm, they tell us who we are and where we have come from, as our new exhibits in two of the museums on the Mall demonstrate: one showing where our pride and our thoughts resided in 1876 (SMITHSONIAN, May 1976); the other, "A Nation of Nations" in the National Museum of History and Technology, which shows the great pilgrimage to this country, the saga of immigration, of which we are the fruit.

As Joseph Ewan wrote in his introduction to a library exhibition in 1972, "Museums are too often looked upon as cemeteries of the sciences, but those who live and work in them know them to be a collection of measuring devices to determine from the preservation of observed facts what is new and different."

I am constantly reminded in these days that the museums, especially our newest, the Air and Space Museum (SMITHSONIAN, June 1976), serve as a prelude to the future, a future to be viewed with conviction, a future which has untapped resources to be developed (see David Lilienthal, p.108), and the certain knowledge that we all have a place in it.

There is a mood afoot in this nation today for a return to friendship, to confidence and to optimism for the future. I'll vote for that.

S. Dillon Ripley

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Phenomena on frontiers of science

Return of the iron age, brain in the golden age, raising sons and daughters and using sun's rays

Our solar system's resident star is highly touted as the most reliable source of energy for the future. The problem, engineers tell us, is that its radiation is both diffuse and intermittent—an accusation which seems diametrically opposed to the facts available to one soggily surviving the heat of the nation's capital in July.

Nevertheless, diffuseness leads to problems of collection, intermittency to problems of storage. A number of solutions—both grand and modest—are being blueprinted now.

The people at Grumman Aerospace Corporation have chosen to run with a scheme hatched by Arthur D. Little, Inc. Their report, replete with color paintings, makes *Star Trek* look like a suburban Cub Scout meeting. It calls for an array of satellite solar power stations (SSPSs), each one weighing 40 million pounds, to be placed in synchronous Earth orbit. Panels of solar cells 3½ by 2¾ miles in dimension would collect constant solar energy and convert it to direct current, which would in turn be converted into microwaves and beamed by an antenna 900 yards in diameter down to Earthly offshore "rectennas" (which from the paintings appear to be about the size of Rhode Island) and turned into electricity, each SSPS producing enough juice, economically it is said, to power New York City.

Well, fine. But while it may be apostasy for someone who labors within sight of the national shrine to space technology to say it, this scheme sounds a bit frantic. Surely there must be a more relaxed way to deal with the sun's diffuseness and inconstancy. There is, according to Alan D. Poole and Robert H. Williams, who chose to dress up their article in the *Bulletin of the Atomic Scientists* (Volume 32, Number 5) with little more than tables and charts. The proper process has been going on without the intervention of human engineering for countless eons. It is called photosynthesis. Green plants convert solar energy to chemical energy with ease, and they can do it almost anywhere on Earth.

The two scientists propose solar plantations and farms in which a plant crop would be turned, by the process of biogasification, into methanol (a liquid fuel ideal for automobiles) and methane (for making electricity), and the by-products of which would be heat (for industrial steam) and high grade fertilizer.

Of course it would take land, lots of land. The authors propose that 125 million acres could be put to such use. It would also take lots of water, so it would only be in places such as our Southeast that solar plantations would be economically viable. But it could succeed on marginal, nonagricultural land, so there would have to be no competition with, say, soybeans or peanuts. Indeed, the authors point out that agricultural detritus, such as cornstalks, could also be used as feedstock for the process.

With reassuring modesty, they suggest that their scheme, though fraught with unsolved technical complexities, could provide 20 percent of today's energy needs. Somehow one believes them.

In the following article in the *Bulletin*, Michael J. Antal jr. points out that producing fuel from organic wastes (flower power, you might say) is only about 50 percent efficient. The process he proposes is what he calls tower power. The tower is a solar furnace. Flat mirrors focus the sun's light to the top of the tower to make heat which is then employed to convert organic matter to hydrogen (or methanol or methane) by the process known as pyrolysis. Dr. Antal calculates that by this means the original energy content of the organic matter would be augmented by 36 percent. He suggests that such power towers, located in the Midwest where crop residues are plentiful, would be

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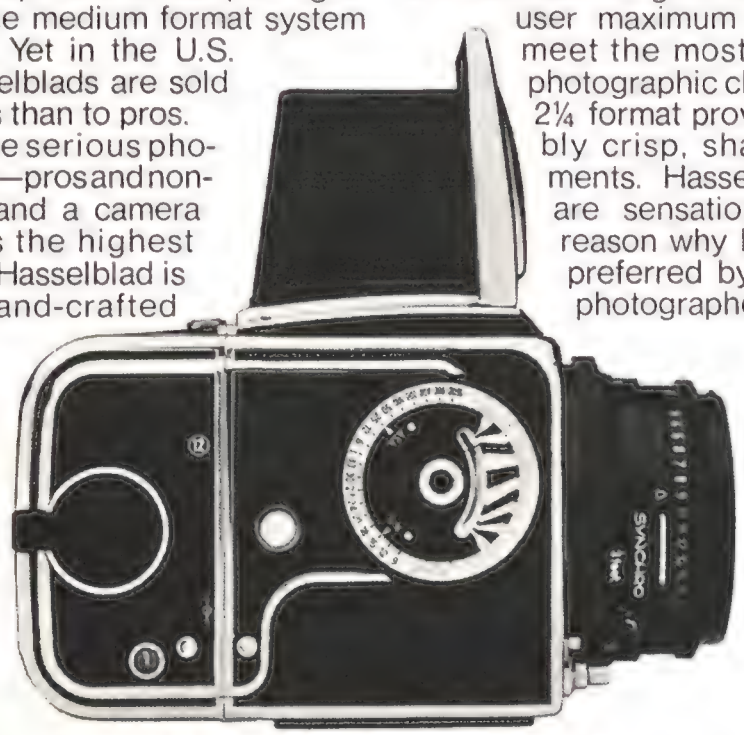

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Rearing future Americans

The subject of childrearing probably accounts for more spoken and written words in our culture than any other—and that is appropriate. It is a field full of truisms, and mistakes, but few facts.

Some of the latter have now been provided by a ten-year study of some 2,000 children and their parents in New York City, conducted by a team of social scientists associated with Columbia University's School of Public Health. The attempt was made to see whether certain kinds of childrearing practices brought about predictable behavior on the part of the children. Some 650 variables were recorded and computed. Even so, the researchers confessed, a lot of important items had to be left out, such as genetic history, diet and so on. (No parent will be surprised that there are more than 650 possible variables.)

In any event, according to *Science News* (Volume 109, Number 20), the researchers found it highly predictable that parents who spank their children often with a strap or a stick, and who deprive them of privileges by way of punishment, will produce fearful kids who fight a lot, are often in conflict with their parents and tend to delinquency.

An excitable mother who screams at her children and is changeable in handling them is likely to visit upon them a host of evils. They will most likely be fearful, isolated and competitive, fight with their parents and their brothers and sisters, suffer from what are called "mentation problems" (which means confusing words and difficulty in remembering things), do badly at school and frequently talk about killing themselves.

Cold parents, those who rarely demonstrate affection for their children, are asking for conflict between the child and its parents and siblings.

Such, at least, is what life seems to be like growing up in Manhattan, and the question arises: what to do about it. Birth control, say the researchers, seems to be reversing the trend to large families. Excitable, rejecting mothers should undergo behavior therapy. As for punitive parents,

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The best way to judge the new Pioneer PL-510 turntable is to pretend it costs about $100 more. Then see for yourself if it's worth that kind of money.

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the researchers suggest that punishment be discussed "with potential parents in high school and during the first pregnancy with fathers present." Somehow this suggestion—let the schools take care of it—seems symptomatic also. All in all, however, one does have to wonder if childrearing isn't too important a matter to be left up to parents.

We may run out of metals

The Club of Rome, those folks who brought us the limits-to-growth controversy, have recently decided that the future is not as limited as they originally thought. Also, it is becoming clear that there is no ultimate energy shortage—just a shortage of certain fuels. But before anyone gets euphoric about the loosening of the shackles on our future, an Australian geologist, Brian J. Skinner, a professor at Yale University, should be listened to.

Writing in *American Scientist* (Volume 64, Number 3), he points out that fuel "is of little use without engines built of iron, copper, zinc, and other metals. . . . If supplies of metals are limited, then society must ultimately be limited, too."

Of course, metals are in finite supply in the Earth's crust, and of all the metal that is extant, only a small percentage is in the form that is recoverable economically. The National Academy of Sciences has estimated that present reserves and past production of copper, for example, amount to three percent of the Earth's ultimate yield. Says Professor Skinner, "With use rates growing as they now are, copper will change from its present position as a metal in apparently abundant supply to a position of strategic shortage by the end of the present century."

Other metals that are likely to be mined out before long are mercury, gold, silver and lead, followed by zinc and chromium. New recovery techniques may arise which will permit us to use leaner ores, but these, Skinner estimates, will require from 100 to 1,000 times more energy. He is lugubrious about the prospects of finding substantial metal ores in the Earth's crust below the oceans: the ocean bottoms are geologically young and have had little time to create concentrated deposits. It will become cheaper and ultimately necessary to substitute abundant metals, such as aluminum and iron, for the scarce ones "and put up with

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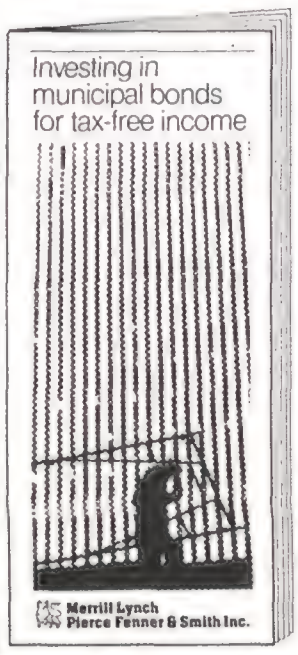

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Frontiers

Several years ago a noted biochemist named Gunther Stent wrote a book called *The Coming of the Golden Age*, in which he suggested that the frontiers of science had been just about reached. This big gun in the Dodge City days of DNA research said that, except in one area of scientific exploration, scientists were merely adding details to the basic structure they all understood.

The one exceptional area is in the understanding of the human brain, but here, he said, we arrive at certain limits: the brain, that single organ of understanding, can go only so far in understanding its own functioning before it reaches an epistemological impasse. This is akin to the physicist Heisenberg's uncertainty principle: the observer, in the very act of observing, changes that which is observed.

Not too many people read Stent's book and of those who did, many said, "Nonsense; people were saying physics was washed up in the 1870s." It remains fashionable today for scientists and others to say, with absolutely no scientific proof, that the human imagination has no limits, that science will always be confronted by yet another mystery.

For a layman thumbing the pages of esoteric science journals, however, it is hard to see that scientists *are* doing much more than adding details to the existing grand perceptions of nature, rather than creating new perceptions. Zoologists and botanists are assiduously seeing to it that their particular organisms or ecosystems do after all fit in with the basic Darwinian theory. If Nessie proves to exist (see SMITHSONIAN, June 1976), it will be a marvel, but one that dovetails smoothly with the other marvels of evolution.

Physicists are still reconciling Einsteinian relativity with quantum mechanics and dealing with particles so small and evanescent that they themselves seem unsure whether they have revolutionized understanding or merely found another apple in the same old barrel.

Geologists, the last to be presented with a new idea—or paradigm, as the jargon has it—are busily weaving all previous and current geological observations into the grand tapestry of plate tectonics. Basic research in genetics is clearly the detail work to permit genetic engineering: few quarrel with the basic scheme.

Philosophers of science say that it is only by this wedging of details into theory that scientists can find the subtle solipsisms between idea and reality that lead to new theories. But what if Gunther Stent is right? What if present theory accurately describes nature?

Well, then we still have research on the brain—entertainment for at least a generation or two.

Almost everyone knows that the eye is an extension of the brain. Interfere with that organ of the brain which is hooked up to the optic nerve and you produce visual disability or blindness. But it turns out the brain may have a fall-back position, as it were. There may be two ways to see.

According to *Medical World News* (Volume 17, Number 10), researchers in England removed the striate cortex of a monkey and thereby rendered the animal blind. Before long, however, it could find its way around obstacle courses and follow moving objects with its eyes. Similar examples of "blindsight" occur among humans whose visual cortexes have been damaged. The optic nerve also connects to another part of the brain, the superior colliculus which, it seems, can take up some of the slack if needed. Certainly the brain provides science with ample frontiers.

It is a cliché, however, that all of it —thought, memory, emotion—will someday give way to the physicists' probing. One day, it is said, a young physicist will take chalk in hand and scratch out on a blackboard the formula for love.

What shall we do then?

The answer is easy. We shall invoke Gunther Stent and the Heisenburg uncertainty principle and have *faith* that the human brain—ornery, elusive, cunning, the ultimate source of energy and excitement, of beauty and ethics—will be able to keep one step ahead of itself.

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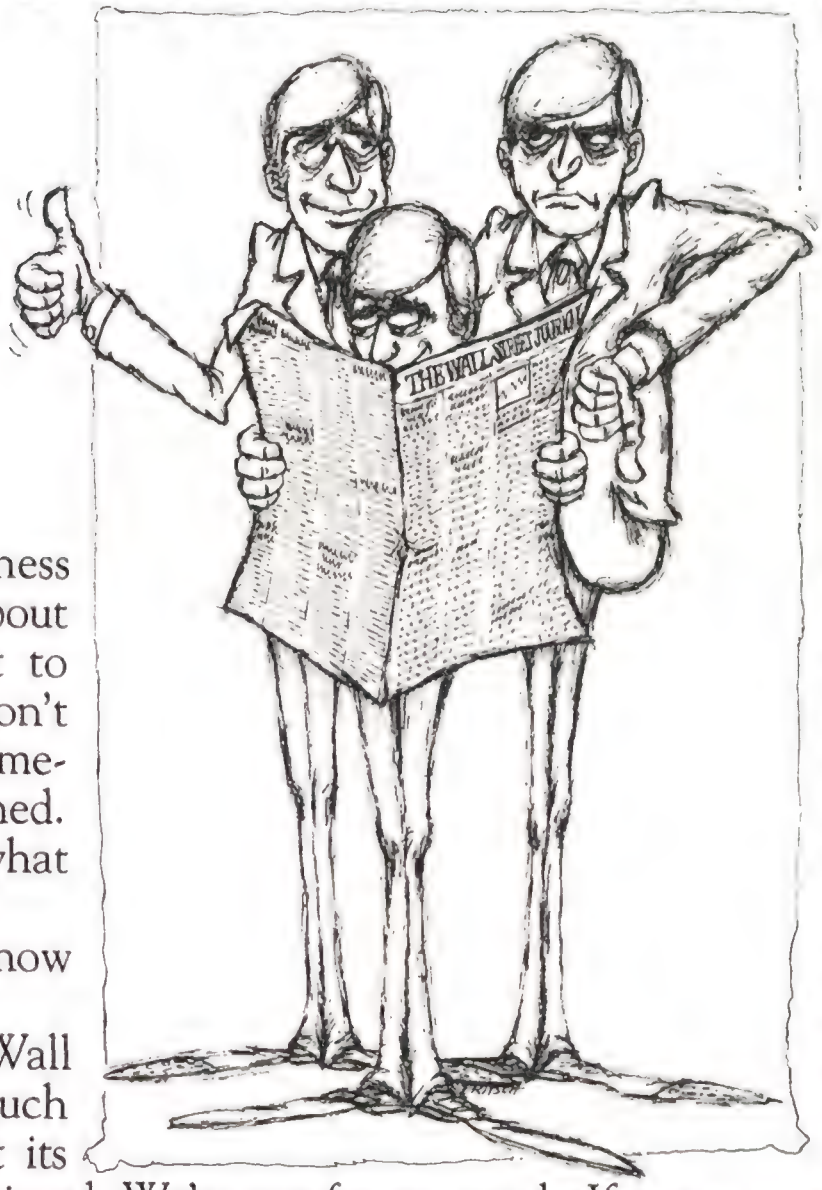

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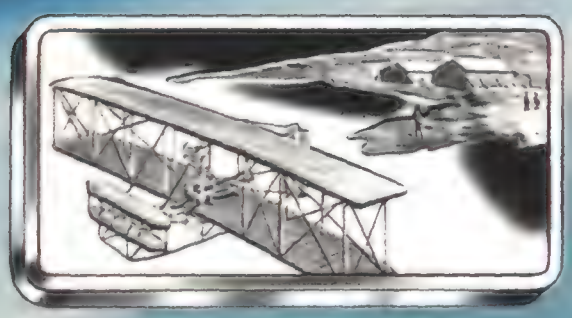

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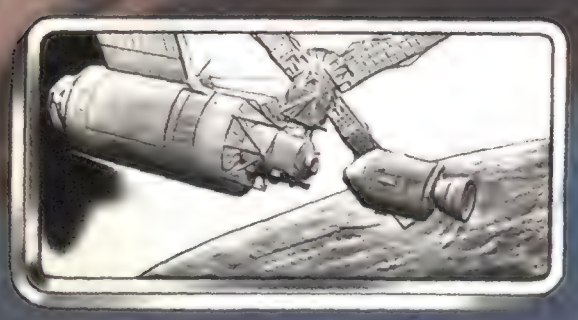
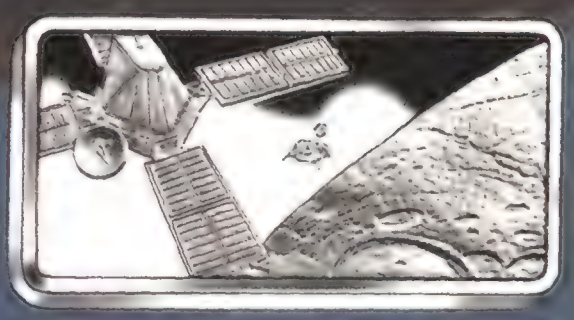
B-24 Liberator, 1941.

Bell X-1 breaks sound barrier, 1947.



Skylab space laboratory, 1973.



Viking mission to Mars, 1976.

Issued in a strictly limited edition.

Limit: One collection per subscriber.

Subscription deadline: July 31, 1976.

ON JULY 4, 1976, VIKING LANDER I is scheduled to land on the planet Mars. From there, its broadcasts to earth may provide the answer to one of man's most intriguing questions: does life exist on Mars?

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A history of America in air and space

The collection will consist of 100 commemorative Proof ingots minted in solid sterling silver. The ingots will be struck for the National Space Institute by The Franklin Mint, America's largest and foremost private mint.

The selections of the 100 subjects for commemoration in this series have been made by the aviation and space experts of the National Space Institute. The first ingot will depict our nation's first aerial voyage—a manned balloon flight that was personally encouraged by President Washington. The last will portray the epochal space voyage of Viking Orbiter I and Viking Lander I to the planet Mars. In between will be magnificent ingots recapturing—in finely sculptured detail—the most dramatic events of America's drive to master the skies and reach out toward the stars.

America's first successful dirigible. The first sustained flight of a powered heavier-than-air craft in the history of man. The introduction of air mail service. The first flight ever to encircle the globe. The aerial conquest of the world's great oceans. The famous bombers and fighters of the Second World War. The dawning of the Jet Age. Breaking the sonic barrier...

The development of rocket power. *Explorer I,* the first U.S. satellite to orbit

Ingots shown actual size

A magnificent collection of 100 commemorative Proof ingots portraying the greatest events—and honoring the greatest heroes—of America's conquest of the air and exploration of space.

the earth. America's entry into space, with our first manned suborbital and orbital flights. Astronaut Edward H. White's famous "walk in space." The remarkable communications satellite, *Telstar. Apollo 11*—man's first lunar landing. *Skylab,* the first laboratory-in-space in history...

Heroes of a New Age. In recapturing these dramatic events, the ingots will also honor the famous men and women who have contributed to America's leadership in air and space.

Their names ring down through history. Orville and Wilbur Wright. Glenn Curtiss and "Captain Eddie" Rickenbacker. Admiral Richard E. Byrd. Dr. Robert Goddard, the brilliant American scientist who launched the world's first liquid-fueled rocket. Charles Lindbergh, Amelia Earhart, Wiley Post. Igor Sikorsky, who invented the first commercially successful helicopter. And our heroes of the new age of space, America's astronauts.

In commemorating these great events—and in honoring the men and women who shaped those events—the National Space Institute's *Official Air and Space Ingot Collection* is more than a superb commemorative series. It is the thrilling story of two hundred years of American achievement in air and space—captured for all time in the enduring strength of solid sterling silver.

A single, strictly limited edition

As the National Space Institute's first commemorative series, *The Official Air and Space Ingot Collection* will be issued *only once.* And each ingot will be minted *only as a flawless Proof*—individually struck from special dies so that the beautiful frosted design stands out boldly against the brilliant polished background.

These flawless sterling silver Proof ingots will be issued in a *single, strictly limited edition.* The deadline for subscribing is July 31, 1976, and there is a firm limit of one Proof Set per subscriber. The total number of Proof Sets minted will be forever limited to *one* for the permanent archives of the National Space Institute and *one* for each individual who subscribes by July 31.

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Monthly acquisition plan

The official issue price for each sterling silver Proof ingot in this collection is $25. Moreover, this price is *guaranteed to each subscriber for the entire series*—irrespective of increases in the costs of minting or the price of precious silver during the subscription period.

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Subscription deadline: July 31, 1976

To subscribe for the National Space Institute's *Official Air and Space Ingot Collection,* you need only fill out the subscription application below and mail it to the official minter: The Franklin Mint, Franklin Center, Pennsylvania 19091.

Please note that you need not make any payment at this time in order to subscribe. But remember: your application *must be postmarked by July 31 to be accepted.* All applications bearing later postmarks will be respectfully declined and returned.

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All applications must be postmarked by July 31, 1976

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What will go on around the Mall

Zealously bending my thoughts toward the future, I have been scurrying around the Institution to learn from various staff members what almost certainly will happen, what presumably will happen, what is planned to happen and what just might happen around the Mall and beyond in the next few years. I am pleased to confirm that the Smithsonian is an upbeat organization. My minisurvey inspired not one suddenly tightened lip or despairingly clapped brow.

Presuming that the future begins next week, the visit of Queen Elizabeth almost certainly *will* happen. The plans are marvelously complete, and the royal court should unite with the honored Institution without a hitch. After all, both parties are well-bred, attractive and enormously experienced in carrying off such liaisons and rendezvous.

Paul Perrot, assistant secretary for museum programs, will serve as our protocol officer for the affair. He says that precisely on the dot of H-hour on July 8, Her Majesty will arrive at *our* castle, step out upon a red carpet and be greeted by Secretary Ripley and Chief Justice Warren Burger, Chancellor of the Board of Regents, both clad in academic gowns. There will also be a fanfare of antique trumpets from the Smithsonian collection. She will visit James Smithson's crypt, look at models of the Mall that help make up "The Federal City: Plans and Realities," then enter the lounge to meet an assortment of Smithsonian people (presumably all checked out by Scotland Yard), see some special exhibits, be greeted formally and, of course, thanked for coming to see us.

She'll zip off after half an hour and drop in at the National Gallery to see that splendid new exhibition, "The Eye of Thomas Jefferson" (SMITHSONIAN, June 1976).

Queen Elizabeth I, the "Gloriana" of the 16th century, used to make royal "progresses" from castle to castle, living off the generosity of her landed barons and so giving her palaces and purse strings a rest. Elizabeth II, in contrast, comes to our castle armed with her own generosity. She is lending the Smithsonian a set of 25 Leonardo da Vinci drawings, possibly never before seen publicly. They arrive six days before the Queen and will be on exhibit for a month at the Museum of History and Technology.

Also due to arrive a couple of days before Queen Elizabeth and stay a couple of days after her is the Duke of Northumberland, present head of the family that produced our own founder, James Smithson (SMITHSONIAN, January 1976). The Duke will be looking in at various places around the Mall—checking up, I suppose, on what's going on at the ancestral benefaction.

Looking further ahead, things get a little mistier. Paul Perrot says the Institution may have a museum support facility, already planned, out at Silver Hill where all those old aircraft fade away while they await restoration and display at the newly opened Air and Space Museum. Basically, the support facility would be designed to increase and clarify the Smithsonian's knowledge of its collections. You think *you're* confused by the sight of 25,000-odd items on display in the "1876" exhibit at the Arts and Industries Building? The Institution is supposed to keep some *five million* items all sorted out.

The facility will help accomplish the necessary cataloging of the inventory, exchanging information between museums, and conserving items.

Television, of course, will be widely used to extend the meaning of the collections and the impact of the museums. Russell Shank, director of the Smithsonian Libraries, hopes to see more sophisticated telecommunications systems (p. 78) in the job of cataloging and interchanging information. Computers are already in use in this area and will be used more.

At the Museum of Natural History, a project is in the offing that is, quite literally, far more tangible. In the old days, says Porter Kier, museum director, people

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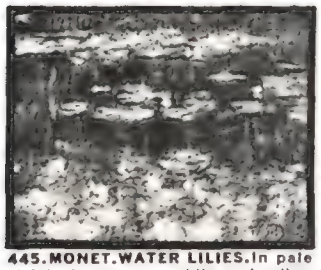

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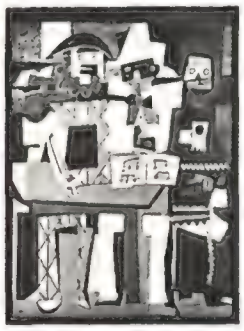

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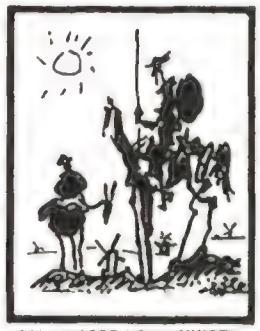

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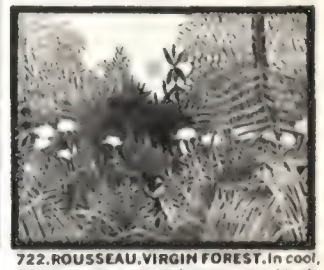

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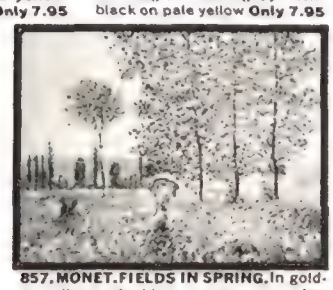

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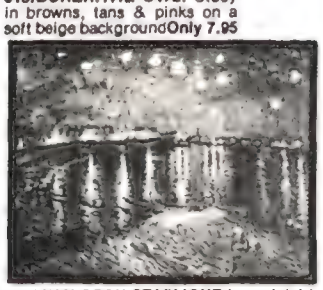

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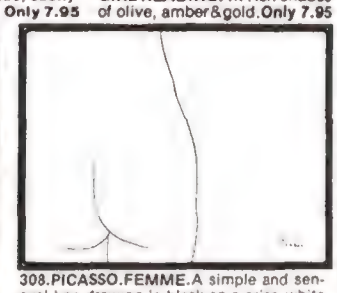

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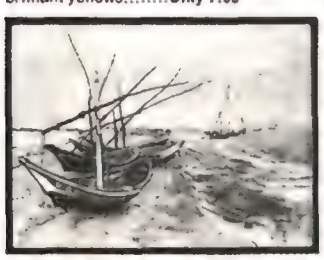

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would wander through the halls of museums trying to match up displays with some cherished discovery of their own that they clutched in their hands—a fossil, a shell, a bit of coral, a bird's skull.

His museum, says Dr. Kier, plans an area devoted to interested amateurs. Here they may actually handle similar fossils to identify just what it is they found in New Mexico last summer. This program will have to be supervised, of course, but Dr. Kier points out that there are hundreds of devoted young people who would volunteer. The program is now opening on a shoestring and will, he says, be fully operational in ten years.

I called Lloyd Herman, administrator of the Renwick Gallery, to see what his museum plans in the way of displaying the designs of everyday living. He says he contemplates some new techniques and would like to focus on different aspects of contemporary design—things like safety and cost and new materials, not just appearance. Plastics, he says, are getting awfully expensive.

I also had a word with Peter Marzio in the Department of Applied Arts at the Museum of History and Technology, and he tells me that the people over there will be working on a complete history of science in America. "From Franklin through Fermi," he says. He also reminds us that we can look for some more First Ladies' gowns in the future years—unless, of course, Queen Elizabeth decides during her visit here to take us back into the royal fold.

Looking ahead. The phrase rang in my mind, growing ever more senseless: "Looking ahead; looking a head; loo king ahead; look ina head; lookin ahead. . . ."

Lookin' ahead. Instantly my father's friend Slocum hove into my mind's eye, gesturing with a knobby finger as he sounded one of his insufferable preachments. "Lookin' ahead," he would say, "is like spittin' into the wind."

No more. No second phrase to explain and triumphantly prove the first. In the northern New England manner he gave you just the bones of it, and left it up to you to pad them out with whatever earthy details sprang to mind.

Yet because I was sitting in the courtyard between the National Collection of Fine Arts and the National Portrait Gallery, having lunch in one of those nice little pockets of Europe that the Smith-

sonian provides—where you can eat a sandwich and somehow feel like a Frenchman—because I was there and had seen some nice things by a turn-of-the-century American artist whom I remembered hearing about, I suddenly knew that old Slocum had indeed finished his thought about the future. For this particular artist whose work I had just sampled had a Slocum story more or less attached to him—an extraordinary yarn that I remembered Slocum telling, back in his New Hampshire barn.

Like many artists at that time, this one eventually settled beside a New Hampshire mountain, painting it in various moods and raising his family to share his delight in it—and in painting. His progeny, like the young Peales, learned from him and became known to some extent in their own right. It was his son that Slocum's yarn concerned, and I will let Slocum tell it.

"Well, sir, he was an odd one, that young fellah. Odd. Lived in his own little cabin, way up near the timber line on the north slope of the mountain. Used to like to take off all his clothes and set in a pool of rainwater in the rocks and eat blueberries and run around nekkid. By the Godfrey, he got awful brown in the summah. Awful brown.

"He was up theyah one February when the weather came up jest as mild as June. So he tuk off all his clothes again and he says to himself 'I do believe I'll go all the way down the mountain and back, and do it nekkid.' So off he goes about one o'clock, daown the trail. And at about one-thuhty the weather changed, jest the way it does that time of year.

"The wind come in from the nor'east, cold and damp, and the clouds come up, and this fellah starts back up to his cabin. But then a little snow comes blowin' in, and he says to himself, 'I'll freeze stiff as an oak log 'fore I get theyah,' and he calc'lates that he'd do better to get daown, off the mountain, and find some way to get warm.

"Another thing he forgot is that sunset comes awful early in February. By the time he heads down again it's twilight, and he leaves the trail and takes off cross country, crashin' through the blueberry bushes and the blackberry thorns and jumpin' over the daown timber.

"At last he gets on level graound, in the dark, and finds a rud, and he no

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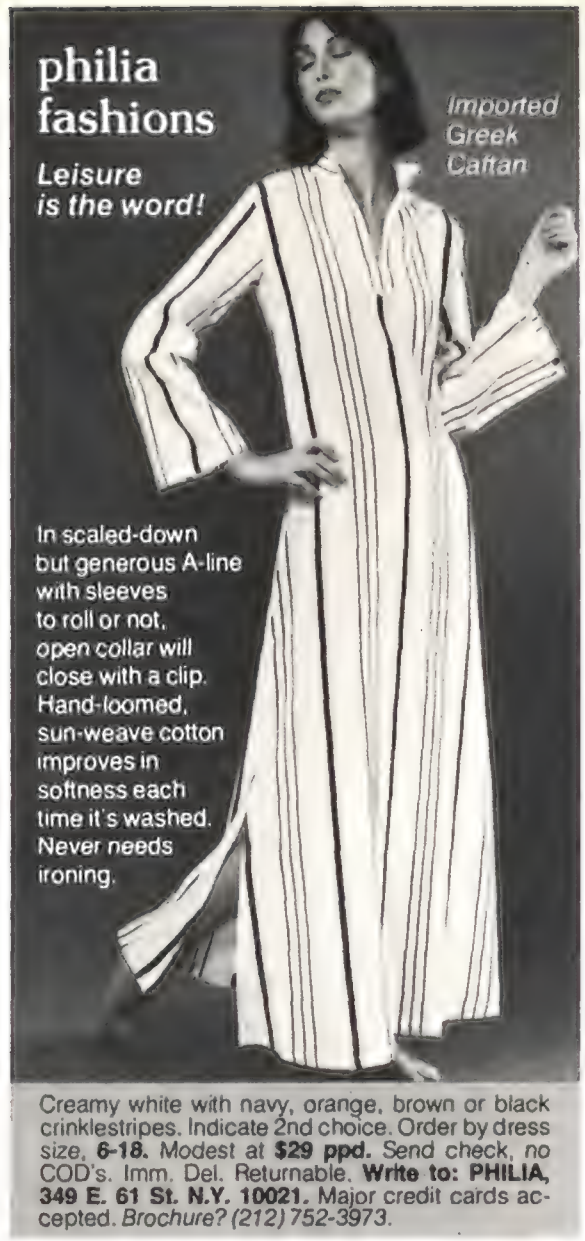
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sooner starts runnin' along it than he sees a lantern on a buggy, abobbin' along toward him. Naow this fellah's pretty odd, but he don't want strangehs to see the way he is, so he jumps into the ditch and waites theyah, hoppin' up and daown to keep warm, nekkid as a frog, all scratched up by the thorns, the snow starting to set in pretty good by now.

"The buggy come closer, the wheels creakin' and the horse blowin' in the cold, and by the Jasper it's old Sawyer, the postmaster, deliverin' the evenin' mail. He's the one whose dotter married that young man from Massachusetts. *You* know.

"Well, sir, this fellah come up out of the ditch, shiverin' and kind of wrappin' his arms araound himself, and he calls out to Sawyer the best he can, with his teeth chatterin' and all, and Sawyer says 'Whoa' to the horse. Then he lifts the lantern off the nigh side and holds it up and looks daown.

" 'Evenin',' he says, just as mild as could be.

"The artist fellah explains that he's got kind of a problem.

"Sawyer said later he was a mite puzzled by it, but he let the fellah crawl in back and wrap up in a mail sack. When he finished deliverin' he tuk him home and got him some clothes. And next day the fellah climbed back up the maountain to his cabin.

"That's all anyone saw of him for quite a spell. Sawyer told about it many times, I recall. He always said it come from tryin' to look ahead. Like spittin' into the wind, he said. He said he never did get his trousis back."

EDWARDS PARK

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A special issue of SMITHSONIAN as America's third century begins

As the world's longest running republic celebrates its 200-year-old history, the future, just off stage, awaits its cue

> I hold that man is in the right who
> is most closely in league with the future.
>
> —Henrik Ibsen

To look back on those who have correctly predicted the future is a humbling experience. The historian Henry Adams seems particularly trenchant writing, in 1910, about energy and entropy in human affairs of the 20th century. Of course, H.G. Wells is the *sine qua non* of technological crystal-balling, and probably the best way to get technological assessment done these days is still not with slide rules and congressional studies but by reading good science fiction.

Nevertheless, the list of people who have accurately perceived the future is short.

Indeed, one wonders if a zoologist present in Cretaceous times, upon seeing nature's crowning achievement thus far—the regal dinosaurs—would have known that it was the timid little protomammals scuttling around in the rocks that had the future in their genes. Had he seen this, he might then have spent some of his time explaining to the dinosaurs that their particular game was in its ninth inning and he would have promptly been branded a crazed Cassandra by the reptilian chamber of commerce.

The zoologist might have been correct about the dinosaurs for the wrong reason. We all have inherent biases. He might simply have had an aesthetic preference for mammals over herps, and reasoned from that underlying bias.

Being few and human, the editors of SMITHSONIAN have such biases and realize that some prejudices are desirable, if only to bring a personal conviction to the creating, assembling and editing of a publication.

From its first issue in April 1970, this magazine has been wary of doomsayers—partly on the ground that they rarely offer solutions—and also Pollyannas (they frequently don't even see the problems). This, then, is one of our biases. Human nature may be relatively fixed, but society evolves. We have always been interested in alternative routes.

From the outset, we have also been in favor of the environment . . . though not at the expense of people. That of course sounds like the empty rhetoric of a waffling politician unless it is seriously coupled with the question of life-styles, energy and economics, all of which are inextricably involved in a complex calculus with which the best minds in our society are continuing to wrestle.

Being part of an institution that is preservator of a great deal of our nation's material past, we go by the twin assumptions that our future can be understood only by knowing our history, and that the future is in all likelihood etched plainly in the present, if only we knew where to look.

Regularly, during the last six years, SMITHSONIAN has looked back at the old days, generally finding them splendid in their own right but believing that the lesson of history is that our forebears faced their world with the same ingredients that we do—a confection of wisdom and folly, farsightedness and myopia.

To select topics for inclusion in this issue of SMITHSONIAN, which deals mostly with the next few decades, is naturally to be subjective. A great number of important topics have been omitted. Their exclusion, as well as the inclusion of what *is* here, reflects in part the

biases acknowledged above, not to mention others of which we are probably not aware.

There is, for example, no article in this issue about the revolution in the role of women. This is not an oversight but a statement of faith that, in the near future, the women's rights revolution will be a thing of the past, a *fait accompli*. It seemed more productive to discuss things less likely to be settled.

There is nothing, either, about the arts in this issue, though that is a regular subject in the magazine. The reason is that no responsible art curator or critic is foolhardy enough to attempt to forecast who will be the masters of the next decade, or even what will be the trends in art. Art is by nature unpredictable and that may be its best feature—the ultimate playing field for the free imagination.

Most of the other subjects which SMITHSONIAN normally covers will be found here, including tomorrow's *Phenomena* by James K. Page jr., who served, with the assistance of Marlane Liddell, as chief of administrative operations for the editor in assembling the issue. Edwards Park rallied Ben Franklin, his family friend Slocum and Tom Jefferson (not necessarily in order of importance) for their modern philosophies. Some subjects are off our beaten track.

On economics, being aware that hardly an American economist has ever conceded that a colleague was correct, we elected to look eastward to England, where we found an outspoken economics journalist who suggested engagingly that the best way that he could contribute to this "symposium" was to lay out 11 outrageous propositions for Americans to consider, in the hope that one or two would seem useful.

And how can one be explicit to readers who have become used to representational illustrations of articles? One cannot, of course. To a great extent, these pages are filled with the imaginative concepts of artists and photographers who, along with the authors, have sought to peer into the next few decades. Are some of them somewhat abstract? Yes, but so is the future.

Of course the views of the authors represented are not necessarily those of this staff or this institution. So varied are the points of reference from which these several authors begin that anyone who agreed with everything in this issue would have to be without the capacity for discrimination.

Those, for example, who agree with the British economist will have to disagree with at least part of another article that touches on the economics of energy and technology. Our attempt ultimately has been to stimulate discussion, to point to some very severe problems that face Americans and the world in the next few decades, and to indicate some possible paths to follow. Perhaps, in all of this, one may perceive who are the dinosaurs and who are the protomammals.

There are no conclusions here, but rather a variety of thoughts from a (to us) satisfyingly disparate band of contributors. They range from a septuagenarian who was formerly a high government official and is now a businessman to a 30-year-old self-made expert in technology and society (p. 42); from a philosophically minded journalist to a somewhat bemused observer of communications prospects.

If any single theme has emerged from the thoughts of these varied contributors, covering so wide a range of topics, it sounds like a basic tenet from the founding days of the Republic. There is a trend (or is it only an urge, a hope?) to place more firmly into the hands of individuals control over their own destinies.

We find that attractive.

—THE EDITORS

By Rod MacLeish

National spirit: the pendulum begins to swing

Settled by optimists, this nation has had reason for pessimism, but it appears Americans can cross at least one more river

The vision of Eden dies hard. The old Adam was expelled from God's grove lest his knowledge corrupt that idyll made of total innocence. Perhaps Jehovah had second thoughts in the numberless eons between the Creation and the founding of Jamestown in 1607. What would have happened if Adam had been permitted to remain in Eden, to gather knowledge—even, perhaps, understanding—and allowed to drive himself to the remaking of that which had originally been perfect in the designs of nature?

This hypothetical situation is relevant—and, if God did have a second thought, the question in it hasn't been answered yet. A powerful sense of being special in the eye and intent of God has been an intrinsic furnishing of the American character. We *have* thought of ourselves as ordained with a destiny separate from the fates of other men and nations.

The concept of America as the New World was literal. This was an Eden of the West where mankind was to have its last, best chance. The 17th-century inhabitants called their prototype "the new Adam." In the 18th century, American intellectuals justified revolution by interweaving the medieval doctrine of Natural Law with Locke's theory of natural rights. They insisted upon the separate and equal station to which the laws of nature and nature's God entitled them—and they got away with it.

The Americans saw themselves as a new race of Israelites created in the latter day and endowed with the same symbiotic relationship that God had conferred upon his first chosen people: Man strives upon a wilderness of land and spirit to achieve the mysterious intent of heaven and, in return, he receives assurance that God's righteousness is his.

Even that hard-headed Founder, John Adams, used the American sense of ordained separateness in his debate with A.R.J. Turgot over the practicality of the Constitution. "The moral government of God and his vicegerent, Conscience, ought to be sufficient to restrain men to obedience . . ." he wrote. God's intent as translated through Natural Law and John Locke had found its closest human and political equivalent in the United States Constitution.

By the light of experience and fortune in the morning of their history, how could the Americans have thought otherwise?

It is difficult to pinpoint the precise beginnings of the erosion of that uniquely American confidence into a uniquely American doubt. The country had always had its domestic critics, warning it to slow down its hustle, get its mind off material things. "The swiftest traveller," Thoreau observed sardonically in *Walden*, "is he that goes afoot." In 1911, George Edward Woodberry peered out from Harvard's assured enclave and found America wanting. "The Democracy in which I was bred was of the souls of men," he wrote, "but the fruit here seems to be of their bodies—comfort and mechanical convenience—admirable but not what we most believed in."

The real erosion began during World War I, although that monstrous clash at an old order's arms was not the primary cause. The brain that hatched the fullest expression of the new doubt was in the head of John Adams' great grandson, Henry, now gone to earth in age and cosmic cynicism. "Each day I live," his brother Brooks wrote, reflecting Henry's pessimism, "I am less able to withstand the suspicion that the uni-

Saint-Gaudens statue, sometimes called *Grief*, adorns grave of historian Henry Adams' wife, Clover, and, in its wintry brooding, symbolizes foreboding that Americans have felt about modern times.

In the small towns of America, before the land filled up, life was free, uncluttered and filled with hope.

verse, far from being an expression of law originating in a single, primary cause, is chaos which admits of reaching no equilibrium, and with which man is doomed eternally to contend."

The universe is chaos. There is no divine order. And if there is no divine order, there is no separate and unique destiny for the Americans. They are just like all the other cultures, societies and nation-states that clutter the face of the Earth. The Saint-Gaudens statue in a Washington cemetery, which Henry Adams commissioned for his wife's grave (preceding page), laments for more than the end of a human journey. It is also the symbol of a shattering sense of loss.

Adams didn't invent the loss. He was just one of its earliest identifiers. The dark suspicion that he articulated has gathered through the decades of modern times—that America really never had an ordained destiny, that it contains within itself a dreadful canker of destruction. In *The Education of Henry Adams* we see one who had led a classically American life, standing upon the American place and prophesying the doom of the planet.

The Americans had suffered loss previously, but nothing as profound and wrenching as this. Upon countless town greens and courthouse squares, granite soldiers stare south or brood upon the generation of flesh that was butchered during the Civil War. Panics and depressions had flayed the financial oat fields that 19th-century America increasingly came to regard as her principal source of nourishment. The philosophic drivel of social Darwinism had, among other things, persuaded a generation of Americans that they were powerless to control their destinies.

Corruption mottled the last third of the previous century, in contrast to the pietistic patriotism in fashion at the time. Washington had told Jefferson that the Senate was to be the great, detached reflector upon public affairs. In the 1880s the price of a Senate seat (paid by bribing state legislatures, which then elected senators) was high—and there were plenty of takers.

These afflictions had dimmed the Eden vision in the self-conception of America—but not for long. There has always been, in the national character, a forward-driving energy, a willingness to cross one more river of chaos, deprivation and difficult choices in order to reachieve the shimmering, promised place.

Families, villages and counties found ways to draw themselves together and proceed onward after the War between the States. Daring, ruthlessness and an appalling optimism had righted the economy when it went wrong. Reform movements awakened a public will to decency which ground the spider of corruption into the American dust. Those rivers had been crossed. Eden *had* been reclaimed and no prophet had ever persuaded the Americans that their crossings were pointless. "Until American idealism had been safely buried [in the first World War]," wrote Ellen Glasgow, "a belief in the happy end was as imperative in philosophy as it was essential in fiction."

What, then, had gone so horridly wrong in the early part of the 20th century? What dark, despairing per-

Mr. MacLeish is a novelist and journalist. His novel The Man Who Wasn't There *was just published. He is commentator for the Westinghouse Broadcasting Company and columnist for the* Washington Post.

Crowded into cities and trapped in a hopeless war, the people overrode the government's policy.

suasion finally buried American idealism in France?

Basically, America had spread geographically, proliferated demographically and become complicated. Its original ideals and order had been designed for an agrarian people. America remained an agrarian nation for about a hundred years after independence. In the middle 1860s the statistically average American was a farmer. By 1900 he was a wage-earner. The Americans had abandoned the pastoral setting of their origins by the millions. They were becoming an urban people.

Meanwhile, the wilderness had all but disappeared. The country was, for all practical purposes, settled from coast to coast (and most of the space between) by the beginnings of the 20th century. Implicit in that fact was the loss of a uniquely American blessing—the second chance.

For most of our history, including much of the 19th century, there had existed the sure knowledge that if a man's life went bad in one place, he could uproot and start all over again on free or very cheap land somewhere else—providing he had daring, resourcefulness and perseverance. There had always been an emptiness to which the disappointed could remove and possibly prosper.

By the end of the 19th century the emptiness was used up; its attendant opportunity was disappearing. The country had reached its physical, geographic limits. The Americans suddenly felt hemmed in by the perimeters of Eden and it wasn't Eden anymore.

Paradoxically, as the continent filled up, the Americans were being increasingly oppressed by a loss of intimacy. The village was giving way to the city as the principal place of habitation. The farm was abandoned for factories owned by someone remote from the lives and beseechings of people who worked in them.

That feeling of disconnection from the comforts of the previous social order and the proprietor of one's means of livelihood symbolized, at the beginning of the 20th century, a spreading, deadening remoteness that was to be the era's principal psychological theme. Even reforms designed to banish the remoteness of the few who controlled things from the many who were controlled became, in time, remote themselves—labor unions, efficient city governments, the immense bureaucracy of the New Deal which was federalism's most dramatic experiment in reform.

The question that has gnawed at 20th-century American history is fundamental: what, in this system, is the value of the individual? The Founding Fathers said that it was paramount. The facts and institutions of 20th-century life seem to say that the individual cannot be valued; the sheer numbers of American souls, problems and responsibilities are so great that the doctrine of the greatest good for the greatest number has come to dominate the way we live now to a degree that its founding theorists never imagined.

This has happened not because 20th-century American federal politics is mindlessly corrupt nor because contemporary American business is greedily evil on the model of its robber-baron ancestors. Government and industry have, simply, grown with the country into what they are—massive, impersonal, inaccessible. Their motives have become increasingly institutional and institutionalized and are distant from the tangled, complex reality of American lives.

Pessimism and a sense of loss

The effect of all of this has been to quicken the velocity of pessimism through the decades of the American 20th century. Loss and anger over loss are reflected in contemporary literature from the sardonic rages of Kurt Vonnegut jr. to the exquisitely delicate despair of Joyce Carol Oates. The pessimism echoes through popular culture—in the doleful wail of rock music's spastic anthems to loss, in the Oscar-winning film *One Flew Over the Cuckoo's Nest* with its bitter theme that madness is sanity, that sanity is mad and will, ultimately, impose a distantly conceived criterion of normalcy upon individualism.

This century has also witnessed bitter conflict in America between those who, for social, psychological or economic reasons, deny the loss of Eden and those who declare that the old conception is no longer valid.

The anti-red campaigns of the 1920s, McCarthyism and the Wallace movement were, at their root, savage bursts of an insistence that America was still God's chosen province and, therefore, incapable of fundamental error.

That conflict reached its height during the Vietnam years. The antiwar movement challenged the assumption of American infallibility at its previously inviolable point—war, soldiers, military glory, patriotism. The basic theme of the antiwar movement was that America was utterly unjustified in what it was doing in Vietnam and, quite possibly, had become a dangerous fixture in the world's present arrangement.

If Vietnam or something equally traumatic hadn't happened, American history would have had to invent it. That ultimate collision of traditional optimism against the new pessimism began, in ways that still aren't completely clear, a resolution of the immense sense of loss that has been the *leitmotif* of this American century.

The antiwar movement won and, thereby, broke through the moats and walls of system, practice, belief and obedience that had made great institutions inaccessible. That is not to say that the Marxists, Trotskyites, Maoists and other crazies on the antiwar's periphery won. Rather, the victory went to great masses of ordinary people who had come to think the unthinkable—that America *was* imperfect, fallible and, quite possibly, dangerous. By withdrawing from Vietnam, the administration had to concede, indirectly, anyway, the validity of that view. People who were disenfranchized and dissimilar in everything except their detestation of the war had finally got through to the most inaccessible institution of their time—Washington.

Along with the successful antiwar movement and the earlier civil rights struggle, there flowered dozens of other new American organizations and protests—women's lib, the environmental movement, local protests against new highways that gutted old neighborhoods, and so on.

All of these were defiances of the modern version of the doctrine of the greatest good for the greatest number. They all insisted upon the value of individual life over bureaucratic government's policies, huge industry's needs, big labor's demands.

Somehow, the resolution of the struggle over Vietnam—or perhaps it was the sheer, frontal exhilaration of the struggle itself—began to diminish the American sense of loss.

Basically, loss is a feeling of abandonment, a disbelief in other possibilities. After the long struggle in Southeast Asia, millions of people began to see other possibilities. You *could* get through to the vast, entrenched institutions that governed life, shake them to their foundations and make them change courses. The demands of individual desires, expressed in collectives of common interest and varying sizes, *could* be heard and acted upon.

The defeat of that truculence which insisted upon the old vision of Eden had spread a light in which a new vision could now be distantly perceived.

The passivity which accompanies a sense of loss was gone with the growing evidence of new possibilities. Henry David Thoreau, who had been resurrected as one of the prophets of the awakened American consciousness, had written at Walden Pond that "Our moulting season, like that of the fowls, must be a crisis in our lives."

The long American moult is ending. Off somewhere, distant but visible in some metaphoric West, the new Eden of restored possibilities is shimmering; it proposes, even promises, that American people and the institutions which govern their lives can rediscover each other and order their purposes in useful harmony.

The achievement of the vision will take time. It will take more argument, outright conflict, the pain of abandoning old assumptions, comforts and interests. Much of that has yet to come. The trouble and doubt that this country has encountered before in its long struggles for correction and improvement lie between the present moment and that still distant vision of a new Eden.

But a familiar old energy is rising. The Americans are gathering a curative power that lies deep in their collective spirit. They are preparing again to cross one more river.

Spring at Walden Pond: Thoreau said to build castles in the air and then to build foundations for them.

By Norman Macrae

United States can keep growing—and lead—if it wishes

A London economist urges this nation to use its old inventiveness, and not to follow the bad example of Great Britain

It is fashionable to say that economic growth will slow down from now on. I think it is much more likely to accelerate. The world's economic history is that, after a big surge when Man stopped being a mainly migratory animal in about 8000 B.C., real gross world product per capita stood practically still for 10,000 years to about 1776. Then it exploded. Real incomes have increased in 19 of the 20 decades since 1776 because of an increase in every decade in our knowledge and control over energy and matter. To this has been added, in the last two decades, a breakthrough in the processing of information, plus a nascent breakthrough in the distribution of information.

Economic growth depends mainly on the advance of knowledge, plus the entrepreneurial drive to put that knowledge into productive effect. Mathematical and other logical calculations which would have taken a month for any team to complete 25 years ago can now be done in much less than a second. This would be an odd prelude to a period during which the world's advance in knowledge by deduction, induction or serendipity abruptly slowed down.

If my guess is right, Man's main problem in the next few decades will be the same as in the last 20 decades: namely, that he is likely to be given some very dangerous toys to play with during another period of vertiginous economic advance, and may use them unwisely unless political leadership in the world continues to be very sophisticated indeed.

Through some happy accident, the two empires

Less finite than some pundits would have it, the planet provides ample room for expansion

of human endeavor through explosions which
may be promising, but could also become threats.

which as a result of very temporary dynamism led the two successive centuries of material advance—the British in the period 1776 to 1876 and the Americans from 1876 to 1976—have handled the task of world leadership rather surprisingly well. The right sides eventually won some of the big hot wars and, especially, the cold ones. This has been particularly true of these last dangerous 30 years of the American century. If we are going to look forward in bewilderment 25 to 30 years, let us also look back in wonder on the same time span. We still barely recognize the progress that has been made the world over and the escapes we have achieved.

In 1946 the average age of death of an Indian peasant was the late twenties; now it is the middle fifties. In 1946 real gross world product was one-quarter of what it is now. The political situation was that the principal arbitrating power in the free world had just plopped into the hands of two apparently small and unknown men—Truman and Attlee—by what was seen as an outrageous historical mistake. That was also the year in which one of my countrymen was, as an act of idealism, giving the secret of the nuclear bomb to a mad Russian dictator, whose qualifications for thus holding in his hands the power to destroy the planet were not comfortingly advertised by the fact that he was soon to want to condemn his doctors to death for not making him feel better on the increasingly frequent occasions when he went to bed roaring drunk.

I am sometimes accused of being too optimistic in what I write. I think, however, that anybody who has been a journalist during the last 30 years has really been living in a state of evaporating nervous breakdown. Now we come to one reason why it may not continue to evaporate.

I am sorry if this seems rude, but I am frankly worried that the American people, with all their power for dynamism and good, may be about to desert what should be their manifest and now rather easy destiny of leading the rest of us toward a decent world society and an abundant cheap lunch. The Americans in 1976 are now showing the same symptoms of a drift from economic dynamism that the British did at the end of their century in 1876. We Britons are experts at describing a drift from economic dynamism because we have spent 100 years observing it at close quarters. There were two signs of British decay by the 1870s.

First, the upper class just about then began to regard business as something rather vulgar, and to look upon new factories as things that were ecologically unfair to their pheasants and wild ducks. That is exactly the mood of America's intellectual upper class now.

Second, after about the 1870s a progressive person in British public life no longer meant a person who believed in progress, or a person who was eager to get down to the roots of the ways of doing things in order to cut and graft wherever an improvement in production or effectiveness or competitiveness or individual liberty could be obtained. A progressive person began to mean a chap who did not like progress and change very much, but who was decently eager to pass on in welfare benefits a larger part of the growth in national income which his own antigrowth attitudes now made it more difficult to attain. That is exactly the change that has also happened in America in these years just before 1976. Most of America's new senators and congressmen since about 1970 might have belonged to the Fabian Society of 1903. Nearly all American public women are Mrs. Pankhurst suffragettes; one can most easily envisage them in bicycling bloomers.

If this gloomy view is right, world leadership is likely to pass into new hands quite early in the next century. If one had been guessing in the 1870s who would take over world leadership from the British, one would have guessed Bismarck's Prussia and been quite wrong. If one is guessing in the 1970s who will take over from the Americans, I would guess Japan and probably be equally wrong. But one is left praying for one's children that it will be a sophisticated, freedom-loving country, because some bizarre dangers as well as great opportunities lie in the years ahead.

The bizarre dangers will include, first, the biophysical. The present orthodox way of creating a human being—namely by copulation between two individuals giving no thought to what the product will be—may quite soon change. Sex is already 99.99 percent for fun, and technology is bound to home in on the preplanned twice-in-a-lifetime occasion when it will be for reproduction. Our children will probably "progressively"

Mr. Macrae's survey of America's third century, on which this article is based, appeared in England's The Economist, *of which he is deputy editor.*

The United States bids fair to lose its preeminence in the world. To whom? It could be the Japanese.

be able to order babies with the shape, strength and level of intelligence that they choose, as well as alter existing human beings by inserting artificial intelligence, retuning brains, or artificially providing pleasure by stimulating the pleasure centers of the brain.

And lots of even more horrid things. The pace and sophistication with which some of these things are *not* done will hang on the world's leading nations, whom other peoples will most wish to emulate or will most fear to fall behind.

One thermonuclear explosion can now release more energy than the explosions of all the TNT in all the wars of history. A thermonuclear bomb is soon going to be almost portable. Quite small groups of fanatics and terrorists and individual criminals will therefore have the capability of destroying the planet. We have not made the slightest advance toward thinking what we will do as that power of blackmail escalates.

It is probable that nuclear weapons technology will come into the hands of lunatic governments before long. Of the 140 or so governments in the world, about two-thirds are run by people who are afraid they might be executed after a violent coup d'état tomorrow. This does not make for a calm and unexcitable state of mind in what will become the profession of nuclear trigger-minder.

The responsibility for this lies largely with ex-colonial powers such as my own. We British left behind in the power structures of those countries ex-Sandhurst cadets and ex-London-School-of-Economics socialists. Those are the two least suitable types for ruling anything in this last quarter of the 20th century; they are now fighting civil wars against each other across all the parts of the map that were once colored an imperial pink. So we economists had better look for ways of correcting these mistakes made by experts in foreign policy.

A major need will be to pump much of the growth in the world's income into the poorest countries.

Unfortunately, two fashionable methods of trying to make poor countries richer won't work. First, nothing but harm will come from conferences on international stability that pass motions in favor of repealing the laws of supply and demand. All those attempts at creating buffer stocks are helping by definition to lock poor countries into products that are going to be oversupplied and unprofitable. Secondly, government-to-government aid does not work. To enable some African government to spend more just by putting money into its hands, and saying it need not worry about the foreign exchange consequences of inflating its internal money supply, does not necessarily raise its real GNP but may just raise its inflation; it is exactly the same as saying that the American government can safely increase its money supply and its inflation because the foreign exchange barrier to American expansion is not large. Why do people not see this?

One way in which the real GNPs of poor countries have been raised, though sometimes in the least essential fields, is by transfer of technology through multinational corporations. It is fine that Volkswagen Brazil and Coca-Cola in several countries have raised their productivity to levels commensurate with those back home, but the most urgent need in the poor countries is not necessarily to raise productivity in motor cars and soft drinks. Aid schemes in the future will have to incorporate performance contracts whereby multinational service corporations can make a profit if they raise nutrition standards, health care standards, educational attainments or provide infrastructure in shantytowns. If the governments of any poor countries do not want such multinational service corporations, then they need not have them. But aid should be tied to projects that will raise real incomes in this way, and in which performance contracts are open to bids in the market place.

Decision-makers who want to retire

The objective should be to raise ever more countries to the sort of income level where their governments will be composed of people who think of themselves and their political opponents as heading slowly toward comfortable retirement, instead of racing to get their brothers-in-law to the firing squad first. Probably the best definition of the sort of government that will not start nuclear fighting is one where the decision-makers assume that they personally will end their lives

No doubt long before we are ready to handle it, we will be able to choose more even than the sex of babies.

in the local equivalent of Southern California, a dacha outside Moscow or the House of Lords. This seems usual at annual GNPs of $1,000 per capita.

Ecologists say that the main barriers in the way of further growth will be a shortage of (1) energy, (2) food, (3) raw materials, plus (4) high birthrates and (5) high pollution. But these seem to me to be the five *least* likely barriers to growth in the next 20 years. Energy, food and raw materials are all three in high elasticity of supply, their production is now in a state of exploding technological innovation, and yet their current selling price to advanced countries is well above even present-day marginal cost of production. The same broad considerations apply to birth control devices and to antipollution techniques—i.e., advancing technology and subsidized oversupply. If we do run into temporary shortages of supply, it is much more likely to be in areas where we do not allow a market mechanism to operate properly, such as water and nonacademic education.

Just as the first, or British, century of industrial advance from 1776 to 1876 was based on the transport revolution of the railways and on steam power, just as the second or American century of 1876 to 1976 was based on the transport revolution of the automobile and on manufacturers' assembly lines, so the third century of 1976 to 2076 is likely to be based on the third and by far the biggest transport revolution—that of telecommunications (p. 78)—allied to knowledge processing. Remember that once a telecommunications system is in being, no greater strain is put on it by ringing China than by ringing the house next door. This is likely to change the whole pattern of our lives, because it probably means that an increasing number of us will no longer have to live near our places of work. We will be able to live in Tahiti, if we want to, and telecommute daily to our New York or Frankfurt or Tokyo office in order to have daily contact with the computers and colleagues with whom we work.

Sociologically, this suggests that the age of urbanization may be about to end and the problems of reruralization about to begin. This will have these consequences for America's three main institutions, which are, in reverse order of importance, its business corporations, its governments and its mechanisms for living together (by which I mean what takes over from church, family, pioneer spirit, small-town togetherness, the probably failed experiment of suburbia, and so on).

We are in any event bound to change the nature of our business corporations. In the industrial countries we have grown rich during the age of hierarchical business corporations, in which each executive arranges what the man below him will do with his hands, all the way down to the man turning a screw on the assembly line. Now, two rather fundamental things have happened. First, we have begun to realize that workers in rich countries don't like working in such places. Secondly, the rich countries are moving out of the postmanufacturing age, but they still have great hierarchical corporations in which executives sit behind their desks trying to arrange what the man below

will do with his imagination. This no longer works. New forms of business organization will have to be found, probably changing big corporations into confederations of entrepreneurs. The firms and countries that will go bust in these circumstances are those that try to replace hierarchical corporations by even more ossified forms of hierarchy—say, by deciding that you mustn't have a boss trying to arrange what free men do with their imaginations, but can have a trade union committee doing so instead.

A new kind of multinational

The process will be abetted by two factors to which I have already referred, the need to move more industry to the poorer countries and telecommunicating. As a prototype for the most successful sorts of firm in 30 or 40 years' time, it may be sensible to visualize small groups of systems designer organizers, all living in their own comfortable homes in pleasant parts of the world and communicating with others in the group (and with the systems designers) by picturephone: arranging for the telecommunication of the latest computerized learning program for making a better mousetrap (or, more probably, for making the next-successor-but-five to integrated circuits) to about 2,000 quickly trainable, even if only newly literate, workers assembled before their two-way teaching computer terminals by some just tolerably efficient organizing subcontractor (also taught by long-distance telecommunicated lessons) in West Africa or Pakistan.

Changes in government and society will differ from country to country. I will talk about America here. The American system has been to set up lots of competing governments—both in Washington and at the local level (where the overlapping among thousands of local authorities leaves any foreign journalist at first feeling stupid because he cannot work out who is supposed to be doing what, then feeling relieved because he discovers that Americans don't know who is supposed to be doing what to whom either, and then feeling bewildered when he discovers that those who are supposed to be doing something don't know what *they* are supposed to be doing). This system of government has one huge advantage, but it also has one growing disadvantage.

The advantage, as Madison saw when he created it, is that multigovernment saves America from being ruled by a "tyrannous majority," or indeed any tyranny. The disadvantage is that it is the most inefficient system that could be conceived for spending money. I have a theory that across most of the world the marginal productivity of new employees in the government sector has for some time been negative, which is awkward because the government sector has become the fastest-growing area of new employment.

Suppose you were an inquiring Martian and asked the normal questions to assess productivity in the public sector over the last 20 years. By how much have crime rates gone down? How far has the legal system become more expeditious? By how much is the urban environment more beautiful and its infrastructure better fitted to meet changing demands? By how much has welfare spending strengthened the family structures of the urban poor and advanced the other intentions most vital for making the poor happy, including especially making them more confident about the atmosphere in which their children are passing their teens? By how much has the huge spending on defense made it certain that you will win in less than Austerlitz's painless ten minutes any war threatened by little countries in, say, Southeast Asia? The answer has to be that, over the past 20 years, and after vast expenditure of the taxpayer's dollars, we are failing each of these tests of productivity ever more abysmally.

Competition for public service

In the free industrial countries we now pick the purveyors of about three-fifths of our goods and services (detergents, for example) through competitive consumer choice, and we pick the purveyors of the often most essential other two-fifths of our services and goods (such as city management) through casting votes. At present the mechanism for picking purveyors of detergents (free market competition plus mendacious advertising plus independent assessments by consumers' associations) is plainly working better than the mechanism (known as the great democratic process) for picking presidents and mayors. This is not a matter of personalities. Elections are the right way of picking whom we want to decide on great issues of peace and war and compassion, but the present government system—namely a fixed, settled, job-protecting bureaucracy with the public just being allowed to vote for whichever plastic, public-relations figure of a mayor it wants to put over it—cannot be as efficient as a competitive market system for choosing the best rapidly changing technology for managing a city's sewage system. We are going to have to move toward voter participation in defining what the community wants from a public service, and then to extend new sorts of market competition to find who can most efficiently provide it.

A difficulty here is that it will make employment in the public bureaucracy the most insecure of jobs, where at present people have come into it after having been promised that it is the most secure job. When a single customer switches from one detergent to another, that does not automatically render all the em-

ployees making the first detergent redundant. In those parts of the public sector where we can bring about reprivatization by voucher schemes, as in education, gradual change will be possible. But a lot of public services have to be provided collectively, so I am envisaging a system where a community will move toward running its environmental services by choosing one performance contractor over another.

The most vital economic question in advanced democratic countries is probably whether we can get our overswollen bureaucracies and public service unions to accept this before they themselves become sufficiently large and powerful totally to resist it. Once you've failed in this, as my own country of Britain already may have done, then your grim prospect is that productivity in the most vital community services will, relative to the new technological opportunities being offered, inevitably decline. You may conceivably be past this stage in America, too, but my hope is that the new telecommuting age—making it possible for many people to live away from their jobs and thus in smaller communities—may reverse this.

The most fascinating conclusion for a frequent visitor to America in the months around its 200th birthday is that the country is obviously on the verge of another change in location and thus life-styles. The two previous runs of this drama had such unexpected results. First, there was the hugely successful period a century ago between about the 1870s and 1880s. In one decade the per capita murder rate in the cow towns and mining settlements was ten to 20 times that of New York City today. Then the homesteaders brought west with them the settled family structures which produced just about the most decent, as well as progressive, small-town neighborhood system the world has seen.

Then, in a single decade between the 1950 and 1960, many things went wrong as the poor poured into the cities and the middle class moved out to the suburbs, unexpectedly making both worse than they were. The influx into the cities proved to be of cowboys, not homesteaders, as family structures of the new immigrants broke down. Meanwhile, in suburbia, Mom went on tranquilizers, the kids on drugs and the working father onto martinis. American universities and planners were not ready for the urban crisis and they castigate their seniors for not recognizing that from the early 1950s on, the rural-to-urban migration had begun to involve 500,000 people a year. However, they say that they've got professors of urban affairs and large urban departments all in place to study the problem now.

Meanwhile, it is unpopular to point out, the tide flows on. In the first years of the 1970s there has been a population rise of just over 350,000 a year in America's nonmetro areas, and telecommuting will surely cause this to increase faster. The new lifestyles associated with this are the most interesting topics for discussion. As an Englishman with no tradition of understanding new frontiers, I always come to the United States eager to listen to such discussion. The silences so far are deafening.

With a net outflow of population from metropolitan areas to rural, more may change than landscapes.

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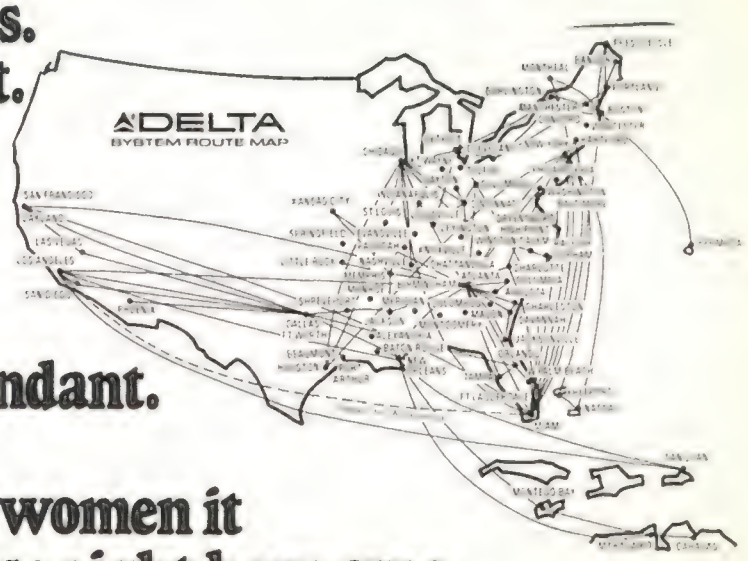

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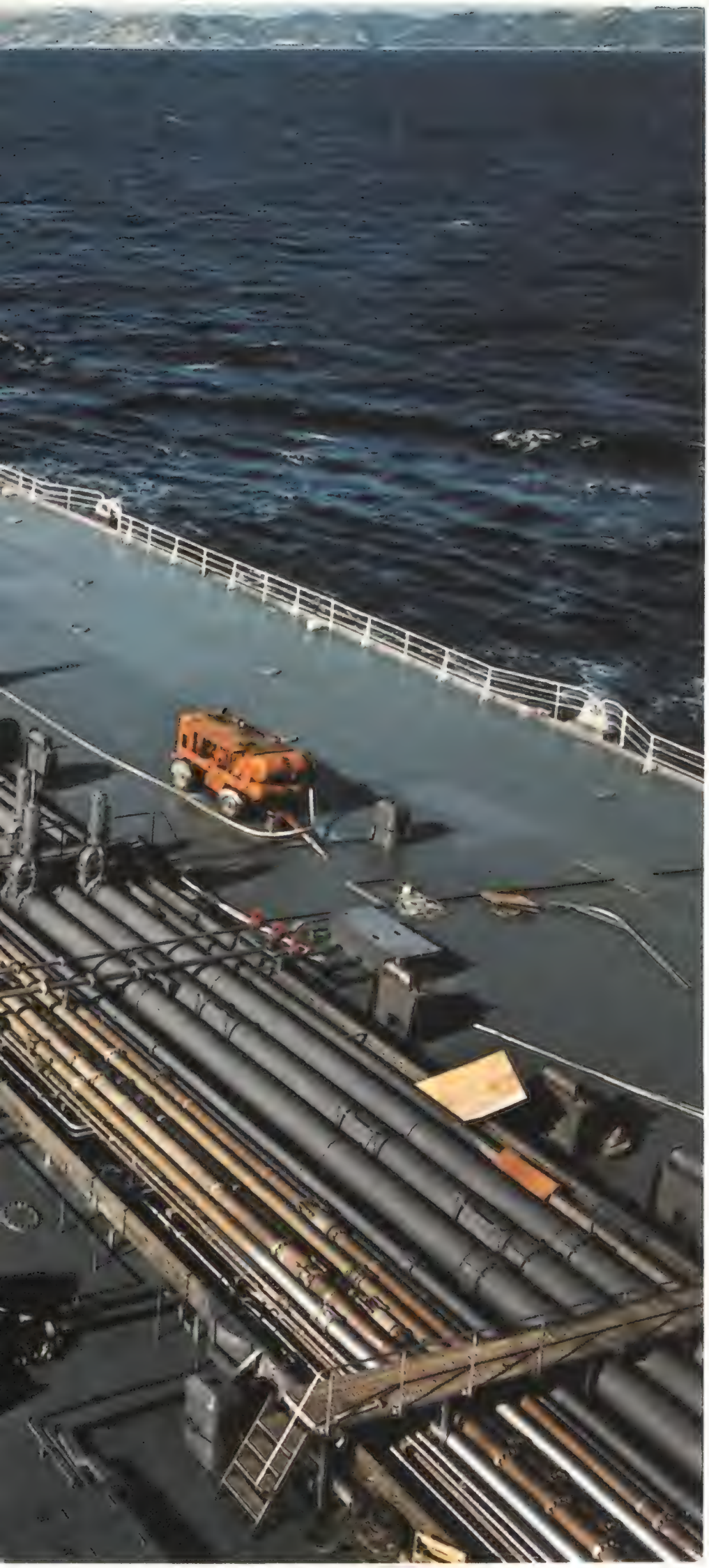

but more vulnerable to breakdown and more dangerous, as a huge oil spill off Spain has shown.

By Wilson Clark

Big and/or little? Search is on for right technology

In an age of the supertanker and the SST, less-developed nations—and some in the West—perceive a need for thinking small

Modern industrial society is characterized by symbols of greatness and size. Man's imprint on the Earth's surface is no longer a few handcrafted shrines like the ancient pyramids but a vast network of industries, highways, buildings. Not only do our modern technological monuments consume an ever-increasing portion of the Earth's energy and minerals, but their proliferation is accelerating the rate of international environmental destruction. A question arises: is our technology appropriate? If not, are there alternative technological and social approaches which can provide employment, reduce pollution and rely on abundant, renewable sources of energy and materials?

Symbolic of the sheer size of our technology is the supertanker. Developed within the last decade, it is the largest moving object ever built. Ships approaching 500,000 tons deadweight now ply the oceans, and behemoth craft of one million tons are under consideration. A ship that big could fit a cathedral into one of its five main oil storage tanks, which descend 100 feet into the water.

A major spill from a medium-sized supertanker could easily equal the *total* accidental spills (200,000 tons) from *all* the world's shipping in 1969. Supertankers rely on complicated but fragile systems to prevent such disasters; many of them are equipped, for example, with only one boiler (compared to 27 on the *Queen Mary*).

Noël Mostert, author of *Supership*, notes their vulnerability: "If that one boiler starts to fail, the ship is

in a desperate state. . . . Without steam, the engines go, and all electrical power as well. The electronic complexity of these ships is wholly dependent upon the main propulsive unit. As steam dwindles and the propeller stops turning, the lights fail, and so do radar, echo sounders, and all other modern navigating paraphernalia. . . . The lot goes. All blink, flicker and die."

The supertanker is not the only symbol of our society's dependency on the functioning of the machine. In November 1965 a failure of a sprawling electric-power grid left the northeastern United States without power for many hours. As our dependence on power grids and on bigger and more complex power plants grows, so will our vulnerability to "blackouts."

The lesson was underscored by a nearly disastrous accident on March 22, 1975, at the Tennessee Valley Authority's Browns Ferry nuclear facility in Alabama when a fire started by a technician's *candle* narrowly missed causing a reactor melt-down that might have "decimated" nearby Decatur, said *Business Week*.

On the road to centralizing technology, many efficient, small-scale processes have given way to large-scale, inefficient systems. In agriculture, for example, the extensive use of machinery has resulted in a system which no longer produces a net output of energy, but instead consumes more British Thermal Units (BTUs) of oil than it yields in BTUs of food to the consumer. The magnitude of risk and waste has prompted an international debate over the scale of technology. It is one thing for productive nations like the United States to use energy-intensive agriculture to help fill total world needs, but is it appropriate for the less developed nations?

Assistance to developing nations by developed ones has concentrated on industrialization and this has created a host of problems. The African writer and technology specialist Jimoh Omo-Fadaka points out:

"Often aid creates a psychological dependence on getting still more aid. It saps initiative and enterprise; again, it may foster—as it has in so many nonindustrialized countries—a type of development wholly inappropriate to circumstance. Industrial plants are created, instead of basic water supplies being improved. Aspirations are created that can never be fulfilled." On the other hand, Omo-Fadaka indicates that the kind of development needed "is one that will produce enough food to feed the whole of the population and that will absorb the labor. In this type of development, agriculture should be the key factor, not industry."

The long-term debt of the developing countries has increased from $40 billion to $130 billion since 1970. Fortunately, many of the technologies the developing world is most in need of are not nearly as expensive as the technologies of the industrialized world.

Pigs at Taiwan's Livestock Research Institute feed on a slurry of algae and grain. The manure is saved.

A recent study of industries and employment in developing countries by the International Labour Office (ILO) in Geneva concluded that new research and development is needed to bring about a "shift to indigenous raw materials, small hand-operated machinery and the use of various waste materials for the generation of energy in individual industrial plants." With funding provided by Sweden, the ILO conducted research in developing countries.

They found, for example, that in comparison with modern, imported tin-can-manufacturing processes, less expensive, labor-intensive processes in Thailand employ more people for a smaller total investment. By investing in a labor-intensive process, ten-year savings would amount to about $500,000. Since local machine shops could manufacture some of the equipment, there would be less revenue spent for foreign parts, and there would be more growth in native industries.

In Kenya, the purchase of second-hand, rather than new, machines used in the processing of jute might offer the advantage of increasing employment and productivity. Machine shops of the East African Railway and small local shops could be employed for "generating new types of technical knowledge in the railway workshops, and . . . might contribute to making secondhand equipment more viable in Kenya."

Although there has been too little effort by corporations and governments to investigate the use of such appropriate techniques in the developing world,

The manure goes into a digester that makes methane to provide electricity and the farm's cooking gas.

Closing the loop, what's left of the digested manure is circulated in ponds to promote algae growth.

a number of small, nonprofit organizations in Europe and America have made great progress in this field for years. The English economist E.F. Schumacher coined the term "intermediate technology" to describe the kinds of approaches and industries needed in the developing world. "I have named it *intermediate technology*," he says, "to signify that it is vastly superior to the primitive technology of bygone ages but at the same time much simpler, cheaper, and freer than the supertechnology of the rich." Schumacher, top economist and head of planning for the British Coal Board for 20 years, paid many visits to developing countries in the 1950s and '60s, observing—with despair—the limited usefulness of advanced technology in solving persistent problems of food and shelter. In 1966 he founded the Intermediate Technology Development Group (ITDG), with headquarters in London.

For example, at the request of the Zambian government, the ITDG developed an egg-tray production machine costing $19,500, which is scaled to the needs of the country. The cheapest machine available on the international market would have cost $390,000, and would produce a million trays a month, far more than Zambia needed. The small machine offers more employment opportunities and lower capital investment, and can be used to fabricate other items than egg trays.

In the United States, a number of nonprofit organizations provide similar services. VITA, or Volunteers in Technical Assistance, located near Washington, D.C., provides a consulting service which uses the expertise of more than 6,000 scientists and engineers who offer free advice on questions of technology and construction. VITA consultants have designed for use in developing countries machines and implements such as windmills, bicycle-powered pumps, spinning wheels and solar cookers. According to World Bank adviser Charles Weiss, "appropriate technology is an issue which lies at the center of development strategy but which at present is being left largely to organizations like VITA."

The developing countries need energy for small industries and home uses (such as lighting, cooking and pumping water). A new project of the United Nations' Environment Programme (UNEP) is testing the use of solar energy, wind power, and fuel production from manure and agricultural wastes for providing the energy needs of villages. Dr. Ishrat Usmani, senior energy advisor to UNEP, pioneered this approach for the development of "Rural Energy Centers."

"As far as the fuel-starved countries are concerned," says Usmani, the former director of Pakistan's atomic energy commission, "the introduction of nuclear power not only drains their limited trained manpower and scarce capital resources, but it makes them totally dependent on imported fuel, millions of dollars' worth of spare parts and even foreign supervisory personnel."

The United Nations has contracted with Oklahoma

Near completion at a Washington state prison farm is this $140,000 methane system which will use wastes

State University and the Brace Research Institute of McGill University (Montreal) to design energy systems for use in the rural centers.

A team from Oklahoma State, which has pioneered in wind-power research, will design a center for a village in southern Sri Lanka, and Brace Research Institute one for Senegal.

Each village center will use a combination of solar power, wind power and energy from agricultural wastes to provide lighting, pumping and cooking needs. The village energy centers will have the installed power equivalent of a 20- to 50-kilowatt electric generating plant.

In many developing countries these technologies will come none too soon: supplies of fuels—such as firewood and charcoal—are perilously low.

In Nepal, population pressures have caused farmers to seek more arable land, forcing a move to less fertile mountainous areas. Simultaneously, villagers seeking firewood have caused extensive deforestation. Erik Eckholm, of the Washington, D.C.-based Worldwatch Institute, describes the ecological havoc. "Topsoil washing down into India and Bangladesh is now Nepal's most precious export, but one for which it receives no compensation. As fertile soils slip away, the productive capacity of the hills declines, even while the demand for food grows inexorably."

To curb this growing problem, the Nepalese government is encouraging land and forest conservation, but the existing population is hard-pressed to find fuel for cooking and heating homes. As nearby sources of wood disappear, villagers have to travel hours to find firewood, or they burn cow dung. Since the dung is needed to restore fertility, burning it only exacerbates the dilemma of the people.

One answer to the fuel problem is methane digesters to convert cow dung into methane gas, used for cooking or heating, and produce fertilizer in the process. The basic technology required to treat manure for gas production has been used since 1900 in India. Methane gas is produced when rich animal manures (and other organic matter) are confined in an oxygen-free closed container (or "digester") at temperatures ranging between 59 and 122 degrees Fahrenheit (15-50 degrees Celsius); bacteria convert the wastes into methane gas at atmospheric pressure through a process similar to fermentation.

According to Brot Coburn, a young American Peace Corps volunteer who has been building home-sized methane plants in Nepal since 1973, a digester designed to use the manure of five cattle will provide the cooking-fuel needs of a family of five. At the current cost of firewood in Pokhara, Nepal, the digester—costing about $400—would pay for itself in about five years. This assumes only the cost of scarce firewood, not the other by-product of the digester, a richer fertilizer than cow dung applied directly to the fields.

More sophisticated methane-digester technology is in practical, day-to-day use in the Peoples' Republic of

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from 350 dairy cows to produce fuel and fertilizer at estimated savings of some $10,000 each year.

China and in Taiwan (see photographs, pp. 44-45).

In the United States, the principles of methane digestion have been used for years to treat sewage in a number of waste treatment plants, but only recently has the process been utilized in an integrated manner for fuel and fertilizer production. One of the largest experimental projects is nearing completion at a Washington state prison farm (see above). With support from the state's Department of Ecology, a small nonprofit research firm in Seattle called Ecotope Group built the entire system at a cost of $140,000. According to designer Ken Smith, the system will provide fuel to run the farm's creamery, electricity for refrigeration in summer, and a nitrogen-enhanced fertilizer of higher quality than the original manure. The system will save more than $10,000 a year in the equivalent cost of fuel and fertilizer.

This innovative project has been built five years ahead of the federal government's plan for a similar plant and at significantly lower cost than the government's budget.

It is no coincidence that most of the projects described here were accomplished by individuals and small organizations, working independently and at low cost; this characterizes the goal of appropriate technologies. Although their application is often confined to developing countries, there is no compelling reason to limit the use of these technologies to countries where agrarian conditions and fuel scarcities are common. In fact, the increasing development of small-scale technologies in America, Japan and Europe indicates that this new industrial revolution may offset the historic tradition of industrial centralization. Tom Bender, architect and an editor of *Rain*, an appropriate-technology journal, says: "Much of the real efficiency of large organization has been its ability to apply inexpensive energy to do our work, yet we now have technologies that permit equally effective use of energy in small applications."

The idea that efficiency increases with size has rarely been challenged, and remains a key concept in economic theory, yet small businesses and organizations are often as efficient in their use of human and physical resources as large enterprises, if not more so. *The Sources of Invention* (a comprehensive book on the subject of invention and innovation by Jewkes, Sawers and Stillerman) states that of 71 major 20th-century inventions, more than half were the product of individual inventors, working without the backing of corporations or government. These individual contributions to technology include the self-winding watch, the safety razor, color film, air conditioning, streptomycin and Xerography.

But the inertial mass of large capital investment works in favor of large organizations in our economy, and government subsidies and laws tend to encourage bigness to the detriment of small businesses and organizations. Even government funding for development of small-scale energy technologies, notably solar energy, has favored large corporations rather than small research groups and businesses which have already developed systems for heating homes and buildings.

Making it official

At least one state government, California, seems interested in helping to develop models for appropriate technology. The governor has established a state Office of Appropriate Technology, under the leadership of the state architect, Sim Van der Ryn. Van der Ryn is planning a number of projects to use low-cost, environmentally sound methods of constructing state buildings to conserve resources and encourage community development.

In a review of the potential for appropriate technology, he comments that "public policy favors and often subsidizes large scale standardized activity at the expense of diversified local enterprise. We subsidize water to agribusiness; highways subsidize long-distance movement of products by large producers; building

codes require the superfluous use of materials and encourage excessive energy consumption; agricultural marketing laws emphasize the cosmetic appearance of foods resulting in the wasting of large quantities of marketable food; health codes, waste and water laws prevent appropriate systems of waste recycling; land-use assessment and taxation policy discourage suitable uses of land—the list goes on."

As Van der Ryn sees it, the new appropriate technology office in California will serve as "a lobby inside government," and its function will be to analyze the impediments which present legislation places on the development of the new, small-scale technologies.

He plans a new state office building that will use solar energy for cooling and heating. The building will save $18 million in fuel bills over its 50-year lifetime.

On the federal level, the Community Service Administration (CSA) has successfully spearheaded a "winterization" program for poor families in the United States. It is considering a grant to a nonprofit organization to establish a National Center for Appropriate Technology. The center will focus on granting money to community action agencies for local projects in energy conservation, community industry and self-reliant technology.

The idea of appropriate technology is derived as much from a vision of a diversified society, of self-reliant and prosperous homes and communities, as it is from technology per se. Just building a few small-scale technology demonstration projects will not accomplish the broader goal of a more human technology. The idea of appropriate technology challenges the existing order of things, especially the values of centralized government, institutions and industries. As E.F. Schumacher notes: "Science and engineering produce 'know-how'; but 'know-how' is nothing by itself; it is a means without an end, a mere potentiality, an unfinished sentence. 'Know-how' is no more a culture than a piano is music."

In the early years of this century, American society and industry were more diversified. The underlying technological characteristic of America a generation ago was community agriculture and industry. Now, instead of the village blacksmith there are automated steel mills and ubiquitous power lines.

Not all village blacksmiths have disappeared, however; a few remain, considered relics of a bygone age. I recently visited the author of a popular book called *The Modern Blacksmith*, Alexander Weygers. Far from a relic, I found him a fascinating and engaging man whose values and education represent much that is admired, although very little that is understood by modern folk.

Weygers, who handcrafts all his own tools, is an accomplished artist and sculptor. His initial education was in mechanical engineering and shipbuilding in Holland in the 1920s. In the first year of his engineering studies, he says that "half of the time spent in school was in the shops, half in the classroom. And the time in the shop was simply to make sure that when you were through with your training, you could compete with a machine. You see, I caught the tail end of the steam age. In the steam age, when you were a marine engineer, if a ship would break down in mid-ocean, the engineers had to be able to do die-making, machinist work, blacksmithing, anything. There was always a shop on board."

Weygers says that "this is what I have cashed in on all my life; the excellence of handwork." Today, he passes this knowledge along to students and apprentices, and is booked years in advance for his classes in toolmaking and blacksmithing.

During my meeting with Weygers, I was amazed that the quality of his tools reflected a precision that I have been taught to associate with machines, not human talent. All the more surprising was the source of his raw material—junk. All his tools are made from the throwaways of modern society—machines, appliances, springs from discarded autos. Just before I left, he said: "I believe that in the diversity of knowing as much as possible about as many things as possible is the source of strength. Our society's specialization is a product of man's fragility."

As I peer at the future course of technology and its effects on our lives, I would prefer the vision of Weygers, the ship's engineer-cum-artist and blacksmith, to the image of the supertanker.

Can we return to the village smithy? A sculptor, Alexander Weygers, has done it with handmade tools.

'Absolutely, Dr. Franklin?'

Two knowledgeable ghosts case modern America with incredulity and some feeling of regret

Because it was the evening of July 2, precisely 200 years after the act of "Independency" had been introduced to Congress in Philadelphia; and because I had been working with blinding intensity to finish my article, *Sociopolitical Repercussions of 1776*, for an erudite biweekly, I was hardly surprised to see the two figures. I had approached my dark red Volkswagen in the university parking lot, and there they sat, in the back seat, as though they owned the car. I could make out, in silhouette, the long hair and strange spectacles of Dr. Franklin and the strong profile of Mr. Jefferson. Unbelievable, shocking, disorienting—but really not surprising in this especial case.

"Gentlemen," I said, "I am honored." I bowed and inserted myself behind the wheel. "You are comfortable?" I asked.

"Comfortable and highly curious," said Jefferson. His manner was far younger than Franklin's and contained a hint of shyness. "What is this vehicle, Professor? Some sort of sedan chair?"

"It is an automobile, sir," I said. "As the word suggests, it moves by itself, thanks to an engine that runs on the explosion of gases."

" 'Auto-mobile,' eh? Yes, yes. Splendid! Can you make it go?"

I turned the key and shifted into low. The car had barely moved when Jefferson positively shouted from the back seat: "Stop! Stop! This is too marvelous to pass without having a dash at it! I must try it, sir! And our United States manufacture this?" he mused.

"The United States manufacture a great many automobiles, sir," I said, falling into the old plural usage of the nation's name, "but as it happens, this one was made in—ah—part of the German states."

"Good God! What Hessian princeling could prove so intelligent as to produce this machine?"

"They have changed, sir," I said.

Under my direction, Jefferson drove confidently out of the university grounds and toward the Thruway. Franklin, alone and slightly white-knuckled in the back seat, peered from his windows with growing excitement. "The lights, sir!" he exclaimed. "The colors and words of light. What wizardry is this?"

"Electricity, Dr. Franklin," I answered. "It has been put to use since you brought it from the lightning."

"Ah, I had a feeling. How wondrous it looks! But I cannot well read these messages. What do these words *mean*? There: 'Chick-n-Eat' and in the distance, 'Drive-in-Movie.' Do we speak our old language still?"

"Barely," I admitted, translating as best I could. Both forefathers seemed amused by the coinages, but rather bewildered by elisions and abbreviations. My explanation of "Motel" was greeted with cheers from these amazingly uninhibited guests. But "Bar-B-Q" baffled them. I pointed out that brevity in signs was essential in the world of 1976. "You will see why soon."

For by then Thomas Jefferson was nearing the Thruway and with some help mastered the approach. But at the first sight of thousands of cars hurtling past, he came to a shaky stop.

"I never imagined such speed," Jefferson said. "Professor, you shall drive us now." And so, on the 20-minute journey toward my suburb, the two figures were free to stare and to ask questions.

"I understand that the speed of your life requires you to read gibberish," Franklin said. "But why read at all? Why not invent some device that will bring voices to you with messages of importance?"

Of course I switched on the car radio. A voice proclaiming the best used car deal in town filled the sedan. Franklin and Jefferson were again delighted—but concerned with the fatuousness of what was being said.

"It *must* be said," I told them, "to pay for using the

'Positively, Mr. Jefferson!'

By Edwards Park

device. Otherwise it would be too expensive." I went on to describe television ("What a sensible word," Franklin put in, "and what a shame to call it 'TV' ").

"There are no rules of—of *deportment* in television?" Jefferson asked.

"We cannot have that sort of control and still maintain our concept of democracy," I said.

"And what is your concept?" asked Franklin.

I thought quickly, feeling the same pressure as a freshman in an oral exam. "Broad freedoms of choice, opportunity and enterprise. We feel we should start from an equal base."

Franklin nodded toward Jefferson. "You see, Tom? For all your doubts, you've had history on your side."

"But who rules, sir? Who rules?" asked Jefferson.

"The people rule through their representatives—at least, that's the idea."

"We know the *idea*, sir. What of the *reality*?"

Soon I was deep in a discussion of lobbyists, pressure groups; of logrolling, vote-swapping, petty graft; of primaries, conventions and smoke-filled rooms.

"Complexity upon complexity," murmured Franklin, his age plainly showing in his voice. "I have a certain appreciation for the—ahem—necessary deviousness of politics, and so has my young friend. But the convolutions that our government now sees fit to go through to obtain relatively simple results would astonish Machiavelli. You have complicated much that should have been simple. . . ."

". . . And simplified—by retaining—much that has always been too complex," added Jefferson. "The Constitution, for example. Have you rewritten it?"

"No, sir!" I cried. "Amended, but not rewritten."

"But why in the world *not*?" demanded Franklin. "This is hardly the same world."

"It is a sacred document, Dr. Franklin. It is enshrined in our hearts."

"God's wit! What secrets does it tell you? How far does it propel you toward . . . toward whatever you are seeking? What *are* you seeking, fellow American?"

I thought frantically, then was inspired: "Life, liberty and the pursuit of happiness!" In the rearview mirror I saw Jefferson nudge Franklin.

There was silence in the car as the traffic flashed by. I found my exit and swung off the Thruway, heading toward our four-bedroom split-level.

"No sunset," murmured Jefferson. "This accursed haze blocks it and stings my eyes. No birds, either."

"No trees for them," Franklin replied. Both were talking more to each other than to me. They stared at the houses. "All alike," said Jefferson.

"Funny smell to them," said Franklin.

"Hamburgers," I said, then quickly described them: "sort of a 'Bar-B-Q.' "

"This is life, liberty and the pursuit of happiness?" Franklin asked a little testily. He put the question to Jefferson, so I gratefully remained silent. But then, around the corner came my younger son, Ned, pedaling his new ten-speed bike. Before I could stop them, the two forefathers leapt out and ran toward the boy.

I saw an exchange of coin, then the two were off, Jefferson pedaling, Franklin astride the bar, the bike weaving erratically down the residential street.

"What a couple of kooks," Ned said as I came up. "They told me this was the ultimate vehicle in efficiency and simplicity. 'Just what we have striven for,' one said to the other. And they've given me about $500 worth of antique gold for it. Far out!"

In the distance, the two figures wove through the thickening mists of twilight, and I faintly heard a voice—Franklin's: ". . . Pursuit of happiness sir! Pursuit of happi. . . ." They were gone.

"Yes, son," I said. "Far out!"

By Thomas Lovejoy

We must decide which species will go forever

With the planet's genetic bank account diminishing rapidly, conservationists may have to lose some battles deliberately

"You are lucky to catch our springtime," said Sandy Wilbur, endangered species wildlife researcher. "It seems to last only a week here." It had been a dry winter in Southern California, but a vernal spell of excitement and anticipation lay upon the land.

Steep hills and canyons were green with the new growth of the introduced annual grasses that have largely displaced the native perennials. The blue oaks and white oaks were about to be transformed from gnarled wraiths by a new generation of leaves.

The ground was covered with the tiny pink flowers of red-stemmed filaree, favorite cattle fodder and now part of a California condor food chain because that endangered bird today depends partly on occasional carcasses of cattle instead of those of the formerly resident elk. I had come on behalf of World Wildlife Fund to determine what further efforts might be undertaken to secure the future of America's largest soaring land bird. The condor, now numbering about 50 birds, appears to have reached a state where it has been so interfered with by Man that it almost certainly will not survive in the wild without intervention.

There is increasing awareness about endangered species such as the California condor (SMITHSONIAN, March 1972). The problem is generally confronted on a species-by-species basis: the Mauritius kestrel with nine individuals; the whooping crane with 85 (61 wild birds, 24 in captivity); the Sumatran rhinoceros with fewer than 50. That there are endangered species of plants as well—some 20,000 of them worldwide—is un-

Illustrations by Jacob Knight

Despite artist's adaptation of the *Peaceable Kingdom* it has had very little peace in the last 10,000 years.

known to most. Generally, the whole lot of endangered species seem to be Lewis Carroll creatures with a rather never-never-land existence. It is symptomatic that many people believe the dodo's existence was confined to *Alice in Wonderland,* rather than being one of the first birds exterminated in historic times.

One of the most fundamental units in nature, the species is one of the easiest for the human mind to grasp, unfortunately leading people to think of endangerment and extinction as a series of discrete events, rather than as something that takes place at an estimable rate. Extinction is not only as old as the history of life on our planet, but the usual fate for an overwhelming majority of species. These natural extinctions were usually caused by the evolution of new, more competitive and successful forms of life or by normal environmental change. The extinction rate has fluctuated, but in general it has increased. At the same time, the number of extant species on the planet has continued to increase, with only occasional minor setbacks, until today the total species number somewhere between three and ten million.

At least within historic time, however, and more likely going back into the Paleolithic Age, a new and insidious extinction process has been introduced. In addition to natural ones, man-made extinctions have been occurring—at first quite selectively to eliminate competition or dangerous animals, or by overexploitation of large edible species (it is known prehistoric Man caused the disappearance of at least such large animals as the elephant bird or roc of Madagascar and the giant ground sloth of the New World). Increasingly, Man has exerted stress, often not deliberate, on the ecosystems of the planet. These systems respond by shedding species just as a plant sheds leaves in response to the stress of drought or cold, and once a species is shed by all the ecosystems in which it naturally belongs, extinction results. The result is impoverishment of the biota of the planet, a reduction of its ability to support Man and other forms of life. The problem of endangered species is not, therefore, a hypothetical one, as some may wishfully believe; biotic impoverishment is an irreversible process that has profound consequences for the future of Man.

There is no question that extinction rates are accelerating. A graph of historic extinctions of birds and mammals follows the same curve as one for human population growth, but the real extinction rates of historic times are undoubtedly several times higher—because, among other reasons, it is almost impossible to remove a single species from an ecosystem without taking dependent species with it.

Today, with soaring human population increase and with the technological ability to assault nature improving to the point where we are capable of wiping out entire ecosystems, extinction rates are going upward exponentially. This is taking place long before the inventory of the planet's species is anywhere near completion. Scientists have described over a million species—perhaps as many as one and a half million—leaving the job 50 to 85 percent incomplete, depending on what estimate one takes of the total number of species on the planet.

Species are becoming extinct today before they are known to Man. Usually we remain in eternal ignorance of what we have lost. Who on receiving a package would toss it out before looking inside? Yet that is what we are doing with our biological heritage.

The tropical forest regions of the globe are some of the richest, both in terms of total species numbers and in terms of undescribed species. Probably only half the fresh-water fish species in the Amazon drainage and fewer than half the soil mites of Amazon soils are known to science. Yet the tropical rain forest is being destroyed at an unprecedented rate. Two-thirds of the southeast Asian rain forests are gone, half of the African rain forests, and more than one-third of the virgin forests of the Amazon have been cut over.

Many of the species of these virgin forests are completely dependent on this primary vegetation and will join the dodo in oblivion if all these forests are cut. Luckily, in the Amazon at any rate, the cutover areas are patchily distributed. Although substantial numbers of described and undescribed species have probably become extinct within the last few years, we have not lost the huge number that would have gone had a contiguous one-third of that forest been cut.

Dr. Lovejoy, one of the nation's most energetic workers in wildlife conservation, is program director of the World Wildlife Fund (United States).

Now a conservation symbol, the whales also symbolize the difficulties of international efforts.

According to one estimate, if all the primary forests of Amazonia were cut, about ten percent of the species stocks of the planet would become extinct. There are current efforts in various Amazonian countries to save some forests, but the results to date are far from adequate; and if the extinctions that have resulted and could result from the assault on the rain forests of Africa and Australasia are also taken into account, it becomes apparent that we are contemplating the loss of a major fraction of the Earth's biota. Predictions of extinction rates of 100 to 1,000 times normal by the century's end, and of the extinction of one-quarter or more of all species, no longer seem unrealistic. No one can afford to ignore or dare fail to be disturbed by biotic impoverishment on that scale.

The folly of such profligate handling of our biological heritage is readily apparent if the focus is not on a species-by-species basis, where our abysmal ignorance makes it impossible to ascertain what "good" a particular species might be, but rather on the worth of species in general. Man's egocentric fantasy world continually distracts him from the basic biology of his existence. Species are essential for healthy ecosystems, which in turn are fundamental to the maintenance of the planet's carrying capacity for Man and all life. Man, like it or not, is still subject to the process of evolution, and the more that can be learned by studying evolution in nature, the more likely it is that one day he might be able to direct his own evolution wisely. How much the humble fruit fly has taught us!

The planet's species also represent a vast genetic resource, the potential benefits of which we have barely skimmed. Many of our domestic animals of today were those of Neolithic Man.

Among the first species to go are large animals, ones requiring large land areas for existence, and often at the end of long food chains. We have little idea of what consequences removing a species at the end of a single food chain would have for an ecosystem.

Many of these first species to go are quite secure under natural conditions, but that very security makes them singularly vulnerable to unnatural disturbance by Man. Island species are typical examples; with small populations, they are in equilibrium with their insular environment which, once breached, is too small to afford opportunities for escape. Many of the large animals have a similarly vulnerable security; as species of stable environments, they have evolved to be closely in tune with that stability, and in doing so have sacrificed the ability to recover rapidly from disruption. They live long, begin reproduction late in life and have few young. Whales, whooping cranes, great apes, elephants—all are similarly vulnerable for this reason.

In contrast are the "weed species" which, like crabgrass and dandelions, have the properties of dragon's teeth, almost seeming to thrive on attempts to control or eliminate them. It may seem paradoxical that it is so hard to eliminate species we willfully set about to exterminate. Rats, roaches and mosquitoes are likely to be with us forever, indeed will undoubtedly witness

It is delicately tuned species that vanish first,
leaving the field to a monotonous array of wasteland.

our own extinction. As a consequence, as biotic impoverishment proceeds, the numbers of weed species will remain constant but their proportion of the total flora and fauna will increase. The planet is becoming increasingly a weed patch.

How effective have our efforts been in checking biotic impoverishment? In some terms, the effectiveness has been considerable. The yearly "World Conservation Product" has risen impressively. The Water Quality Act, the Endangered Species Act, the Washington Convention on Endangered Species and many other acts of governments represent tremendous strides. Nonetheless (I would unhappily conclude), in terms of the scale of the problem, we can say with John Paul Jones that "we have not yet begun to fight."

Limited resources of manpower and money are in fact forcing us into employing on a planetary scale an environmental form of triage, the practice evolved by Allied forces in World War I of sorting the wounded into three groups: those likely to die despite medical care, those so lightly injured as to probably recover without care, and the remainder on whom medical resources were concentrated. Should we be deciding on which species and which ecosystems to use our meager conservation resources? And which species and ecosystems should we decide to write off?

Can we possibly save a representative series of species as living museum collections, scattered in various protected ecosystems throughout the world? If this were possible, then once Man's mad assault on the natural systems of the planet abates, once the enormous population increases already essentially inevitable are checked and population diminishes to reasonable levels, and if only we haven't spread too many poisons about, *then* might a portion of the planet be reclaimed by the wild? Even given all the ifs, it would not be possible without that representative series. Extinction is permanent, final. Man with all his terrifying ability to destroy species and ecosystems will never have the power to resurrect even a single individual of even one species he has eliminated.

Environmental triage has not been widely practiced in the past. When the numbers of endangered species were small, it did not seem necessary to choose between trying to save the ivory-billed woodpecker or the whooping crane. With longer and growing lists of endangered species such choices are being forced. Man's appetite for cellulose is so insatiable it would shame a termite; is it then realistic to try to save hole-nesting birds such as the Puerto Rican parrot (20 birds) which require large old timber tracts?

Should triage be based on the ease or difficulty with

which a species might be saved? Perhaps we should write off the most endangered species and concentrate on those for which our efforts won't be so easily jeopardized by random events. Would it be wiser to take the $15,000 currently devoted yearly to the nine Mauritius kestrels and use it to establish a reserve for the 100 or so St. Lucia parrots, or a reserve for the pigmy hogs of the Terai of Assam and possibly Nepal, once thought to be extinct but rediscovered in part through the efforts of Gerald Durrell's Jersey Wildlife Preservation Trust (see SMITHSONIAN, September 1972)? Should we try to save the leopard rather than the cheetah, because the space needs of the latter are so demanding? Would the conservation community suffer a loss of faith if an endangered species were to be deliberately written off, or is it the only way the point can be made about the plight of the world's animals and plants?

Genetic considerations certainly play a part in determining how easy it might be to save a species. When a species drops to low numbers, its genetic variability and flexibility is considerably constricted. Past low numbers and genetic constriction are reflected today in the genetic composition of the two California elephant seal populations. Lethal and sublethal genes may become prevalent in a remnant population. Something of this sort indeed is responsible for the low reproductive ability of the major captive breeding stock of the nene (Hawaiian goose), but happily a few birds with substantial reproductive potential have survived in the wild.

Say goodbye to the red wolf?

On this subject, which is of such importance to captive breeding and other conservation decisions, we remain woefully ignorant. We know that there are no lethal genes in the wisent (European bison) population which dropped to less than 200 in the early 20th century, and there may be none in the little Laysan duck of the western Hawaiian islands, which is now known to have had as close a brush with extinction as any sexually reproducing animal can. A female, found in 1930 sitting on a nest of eggs broken by seabirds, fortunately had enough remaining semen from her deceased mate in her oviduct to lay a second clutch. Occasionally, genetic problems of another sort arise, such as those of the red wolf, probably the next American mammal to become extinct unless action is taken. Land-use alterations of forest cover have brought the coyote in contact with the red wolf, and the interbreeding taking place is swamping out red wolf genes with coyote genes. Few red wolves remain.

Sometimes the tumultuous affairs of our own species force a triage. Such would appear to be the case both with the giant sable antelope of Angola and the kouprey of Laos and Cambodia, although our relative inability to do anything for these two species does not automatically imply that the two large ungulates won't survive the current troubled times.

Far more worrisome is that environmental triage is being practiced unconsciously. That the future of the emperor tamarin is relatively secure because of Peru's Manu Park is not totally accidental, but the park was not established as part of a conscious over-all plan to conserve the flora and fauna of the entire Amazon Basin. Colombia's magnificent new Macarena National Park is important in terms of a lowland rain forest park for that country, but will it preclude the reserves for the perhaps 100 endemic bird species in that nation when Macarena itself has not one?

Going, going . . .

Among the species that are likely to disappear next, either by human inadvertence or natural disaster, or other causes, are these listed by Dr. Lovejoy:
Birds—Kakapo (New Zealand owl parrot), Puerto Rican parrot, Chatham Island robin (New Zealand), Blewitt's owl (India).
Mammals—red wolf, golden lion marmoset (Brazil), pigmy hog (Assam), Mesopotamia fallow deer, hispid hare, (Assam), yellow-tailed woolly monkey (Peru), pileated gibbon (Malaysia).
Reptiles and amphibians—Round Island boa (two species) (Indian Ocean), gavial (India). Orinoco crocodile, Israeli painted frog, golden frog (Panama).

There is a rapidly growing need for a more decisive, more deliberate approach. The Nature Conservancy is consciously attempting to save the full diversity of America's ecosystems. This means, of course, that the Conservancy has essentially written off further New England hemlock groves from its program, leaving any additional efforts to local or other groups. The Conservancy's powerful state heritage program is designed to insure that priority for areas a state is to conserve will go to an ecosystem type not yet protected in that state, rather than duplicate an ecosystem already in an existing reserve.

In South America, the World Wildlife Fund is involved in similar efforts. Costa Rica designed such a priority system a few years ago. A study to identify centers of endemism of the birds of the northern Andes is under way, and a comprehensive effort to establish a master plan for conservation in the Brazilian Amazon will soon be initiated.

In all cases where choices must be made among species, ecosystems and duplication of habitat reserves, we are nonetheless operating in considerable ignorance of what it actually takes to conserve permanently a biological community. Recently, recognizing that most reserves are destined to become islands of natural habitat in a sea of Man-dominated environments, theoretical ecologists working on island biogeography have indicated that the very geometry and size of a reserve affects its ability to hold species over time. There is a minimum critical size that must be exceeded in order to guard against heavy loss of species from the reserve. Initial estimates based on rain-forest birds indicate that the lowland forest reserves of South America must be at least 1,000 square miles in extent; the minimum size may be even greater.

The realization has come late; most of the planet's present parks and reserves were established without the minimum-critical-size problem in mind. A number of the areas previously set aside have been large, but they are still far from sufficient. On New Guinea alone, 60 percent of the bird species are extinction-prone if large reserves are not established.

Equally disturbing is the effect of fragmentaton of unprotected habitats into islands. The spring migration in North America is not only taken for granted, it is big business: the total contribution of bird watching to the Gross National Product in 1974 was 500 million dollars. I can remember being with the Smithsonian's Gene Morton on a spring evening two years ago when, at his call, we were suddenly surrounded by myrtle warblers. An icy thought struck home: there was no reason to assume that this incredible phenomenon of life, of thousands upon thousands of brilliantly colored birds traveling thousands of miles twice each year, would necessarily continue.

My concern then had been about the wintering grounds of the migratory forest birds. Little was known of their needs in this regard, and yet I knew the forest was disappearing rapidly in Latin America. Only recently I learned that the fragmentation of the Eastern deciduous forest is having its own detrimental effect. As the islands of forest become smaller and more isolated from the remaining big patches of forest, the percentage of migratory birds in the summer censuses decline dramatically from around 92 percent in large forests to the 35 percent or lower characteristic of city parks. This process is sufficiently precise for the order in which bird species will be lost to be fairly predictable, with species such as the black and white, the worm-eating and hooded warblers going first.

Everywhere biotic impoverishment seems to be going on even faster. Will conservationists be able to retain their necessary optimism, indeed their sanity?

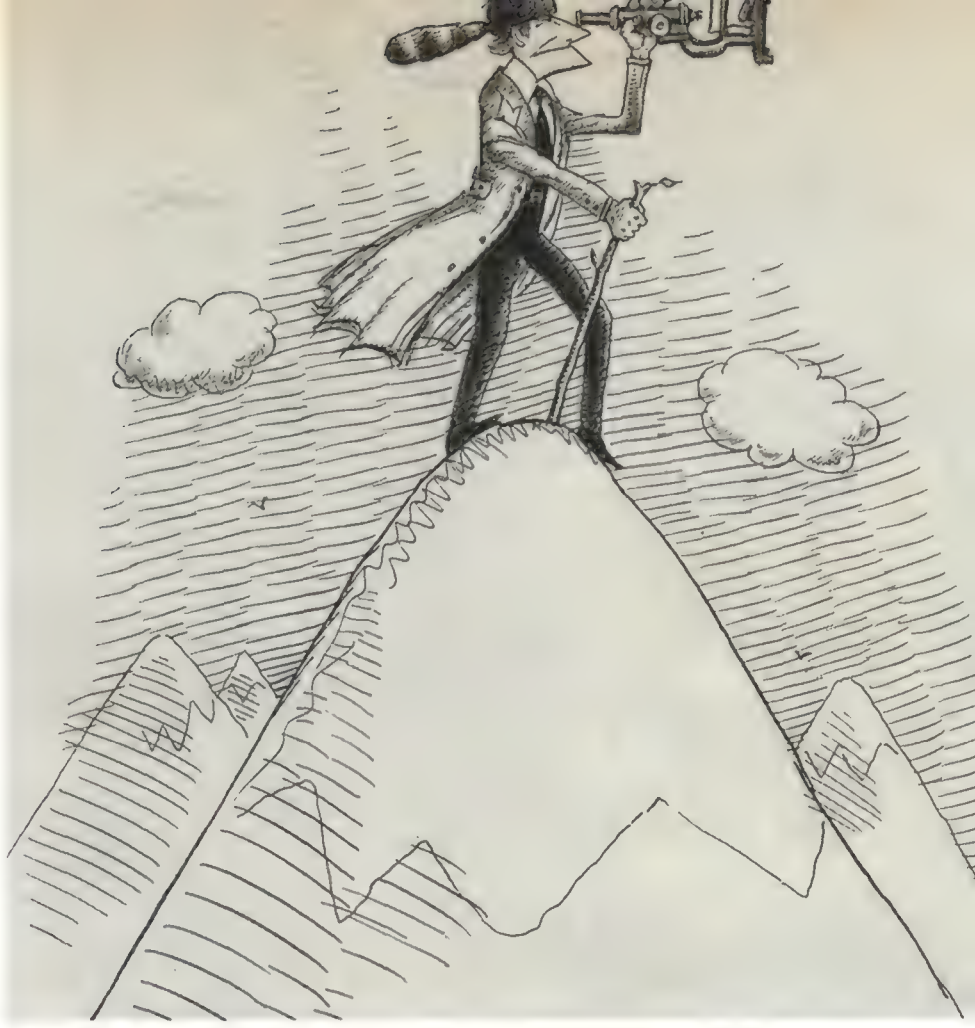
Later I stood on a high ridge overlooking the Sespe condor sanctuary, a chill damp wind tugging at me as I gazed out toward the condors' last nesting sites. Violet-green swallows and white-throated swifts performed pirouettes on the updrafts of which the condor is so much the master. I wondered what the future held for the condor and other wildlife. If their fortunes could be told, which species had a future? Which must go unheralded, which would go or stay by willful, conscious decisions? Most of all, I found myself in frustration, pondering the imponderable: not *should* such decisions be made, but *why* should they have to be made, as I know they do? Why couldn't there be room for all?

If Man survives on the planet, with whom will he share it? Domestic animals—or cockroaches?

By Daniel S. Greenberg

Scientists wanted—pioneers needn't apply; call AD 2000

Science and technology—this century's frontier—are learning how to work within the limits set for them by nonscientists



Everest of research falls before our intrepid, if shortsighted, mountaineering scientist.

Science continues to mold our future, but what of the future of science itself? It seems impossible to predict what the most exciting frontiers of physics or biology will be in another quarter of a century, but we can be surprisingly confident of what life will be like in the American scientific community. With a very unscientific time machine, we can collect two eminent scientists from the last turn of the century and transport them into this future, letting their experiences define the changes.

The first scientist, a young man with a mediocre academic record, used good family connections to obtain a job in the Swiss Patent Office in 1902. A one-time high school dropout who had been told by a teacher that "You will never amount to anything," he had relied heavily on borrowed lecture notes to get his undergraduate degree. But he had aspirations beyond patent applications.

Now imagine the time machine has transported him to the last quarter of this century. Envision the young clerk anxiously opening a letter from a foundation to which he had applied for a graduate fellowship to study physics. Disappointment shrouds his face as he reads the response:

Dear Mr. Einstein:

We are in receipt of your application for financial assistance to pursue graduate studies in physics. Having examined your academic record and references from former teachers, we regret to inform you that your preparation is inadequate for the rigorous requirements of the course of study that you wish to follow. Therefore, we are unable to act favorably on your application.

Sincerely,

The Graduate Fellowship Committee

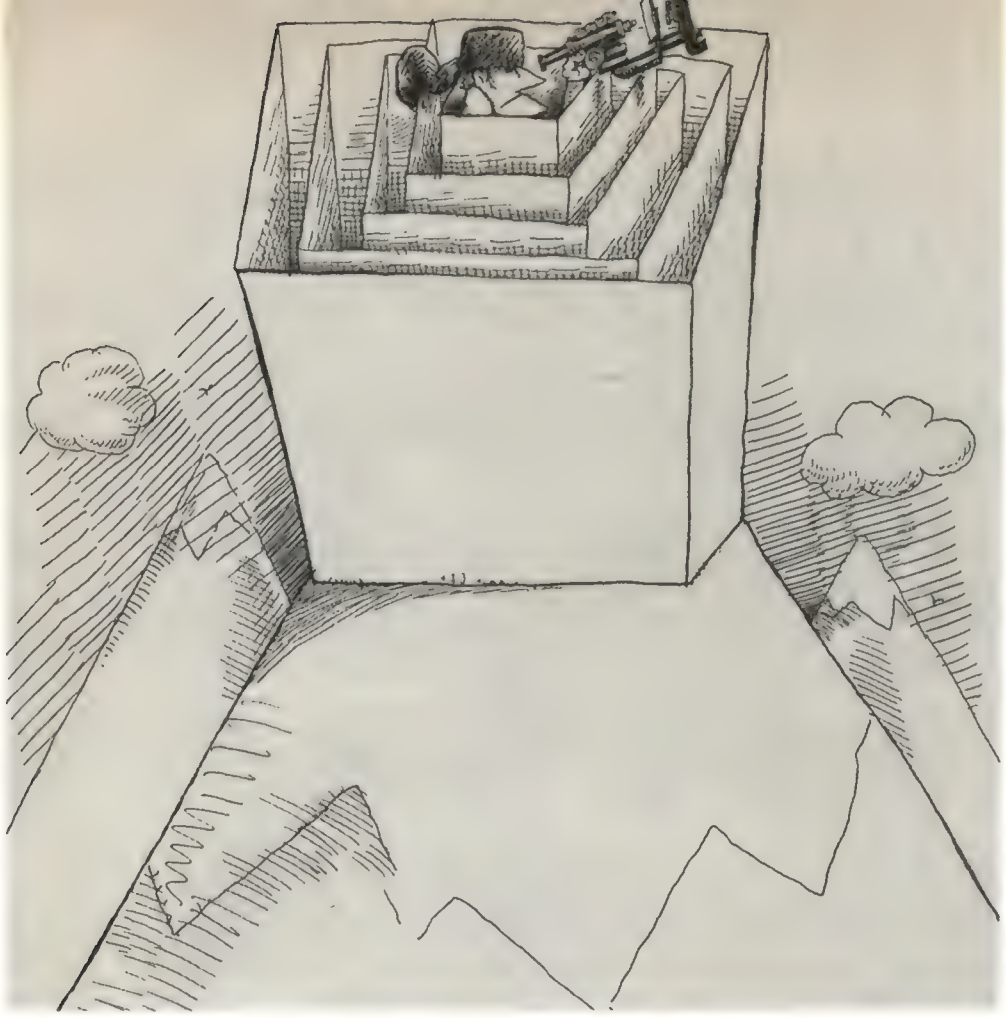
To meet a second time-traveler, turn back to 1900. An Army surgeon holds the unorthodox notion that yellow fever, then epidemic in an American protectorate, Cuba, is transmitted by mosquitoes. Since there is no way to test this hunch on animals, he proposes to test it on humans. Suddenly he, too, finds himself in the final quarter of this century. Submitting his plan to his superiors, he is rewarded with the following memorandum:

From: Surgeon General, U.S. Army

To: Dr. Walter Reed

Subject: Human Experimentation, Regulations Concerning

As we are sure you are aware, any experimentation involving human subjects must conform to the informed-consent regulations that the Department of the Army has adopted from the Department of Health, Education and Welfare in accordance with directives of the Federal Council for Science and Technology. As a preliminary step toward fulfilling the requirements for application for issuance of a human-experimentation permit, it will be necessary for you to submit a detailed protocol of animal studies. In conjunction with regulations concerning animal welfare, it will also be necessary for you to



Will the maze of regulations on top of tomorrow's peak be as yielding to the conquering spirit?

provide evidence that the preliminary studies cannot be accomplished without the use of animals.

Failure to comply with this memorandum will result in disciplinary action.

The addressees are real, but the correspondence, of course, is mythical. Patent Clerk Albert Einstein was spared any such rebuff when he sought a graduate fellowship. Working at theoretical physics in his spare time, he quickly published five papers, including the special theory of relativity, and was awarded a doctorate by the University of Zurich.

And Dr. Walter Reed simply followed the honorable tradition of using himself and his research-team colleagues as experimental subjects, without encountering the present-day committees that are concerned with animal-welfare regulations and informed consent of human subjects. Some of his co-workers died, but Reed proved his point. The mosquitos were eradicated and the number of yellow fever cases dropped to zero.

Our heroes of the past thrived in what might be called the frontier days of scientific research. Vast and open territories of the scientific unknown lay before any investigator, and virtually all that was required for plunging ahead was the wit and the will to do so, plus relatively minor sums for equipment and supplies. How different it is today, and how much more so it will be tomorrow!

Peering ahead to the turn of the century, I see a crowd of people concerned with science—but surprisingly few of them are wearing lab coats.

The crowd is mainly composed of legislators, lawyers, economists, diplomats, budget planners, aptitude testers, bookkeepers, labor union officials, technology assessors and lots of anxious citizens. Few of them can distinguish an electron microscope from an automatic olive pitter. Their presence in the heart of the scientific enterprise signifies the blossoming of a theme that is already with us: namely, science is too potent, costly, dangerous and valuable to be wholly entrusted to mere scientists.

During the next quarter of a century, research will thrive in terms of expenditures, scientists and technicians at work, ambitious projects and costly facilities. But it will do so as a tightly reined captive of the surrounding society, and in an atmosphere of caution and thrift. Most important, opportunities for scientific research will no longer be judged in the traditional terms of knowledge being a desirable goal in itself regardless of the purposes to which it might be applied.

Scientists and research administrators will find that whole regions of research and technological application have been declared off limits, shunned as economically unworthy of pursuit or legally prohibited as too dangerous to be entrusted to frail humans and their unpredictable social and political institutions.

Research in many, if not most, fields will be actively encouraged, for the thickening problems of mankind on a crowded globe will demand scientific and technological solutions. But the choice of what to research will not be left entirely to the people who perform the research. Rather, it will receive the scrutiny and require the approval of a wide-ranging assortment of nonscientists who are concerned with costs, priorities, social impact, public safety and political significance. The "Everest Complex" will no longer be sufficient reason for undertaking many research projects. Scientists will find that "because it's there" isn't a convincing argument to use on the keepers of the administrative cage in which science is confined.

The next 25 years will also produce further changes in the internal affairs of the scientific community, largely as the result of the progressive mechanization of scientific research. The conduct of most kinds of research is impossible without the use of highly expensive facilities—computers, particle accelerators, space satellites, oceanographic vessels, huge banks of experimental animals. There is and always will be a market for the breakthrough genius, but without the assistance of sophisticated apparatus, genius will be to science as expert archery is to modern military affairs—admirable, but ineffective by itself. Theoreticians may

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Illustrations by Stan Mack

Doing more research, enjoying it less

still use their traditional tools, paper and pencil, but to test their work they like to have a powerful computer which can race through calculations that would require weeks, even years, of hand computation.

Big science thus means big organizations. The machinery of modern science spawns a cast of characters that includes budget planners, technicians, maintenance people, and so forth. Schedule makers reign supreme when the lineup of would-be users overwhelms the available time on a machine. Big organizations mean layers of administrators, divisions of labor, and tendencies to assign people to preconceived duties rather than permit them to flourish according to their individual abilities.

When a few test tubes and a microscope constituted a "laboratory," research could be done in a spare room as a spare-time occupation. (Our patent clerk did his research on a kitchen table!) But when the tools required for research are million-dollar rockets and atom smashers, the number of persons who are professionally capable of using the tools will always be in surplus supply; patent clerks with abysmal academic records need not apply. These conditions will be particularly onerous to the freewheeling pioneers who people the history of science and technology. Charles Lindbergh picked himself to fly the Atlantic, but committees of physicians and psychologists selected the astronauts who went to the moon. The turn-of-the-century scientist will have to harmonize with his societal and professional setting. To put it bluntly, the scientist will, with rare exception, be a member of a scientific and technological proletariat, well trained and competent, but no more distinguished from the mass of his colleagues than is, for example, an automobile assembly worker of today.

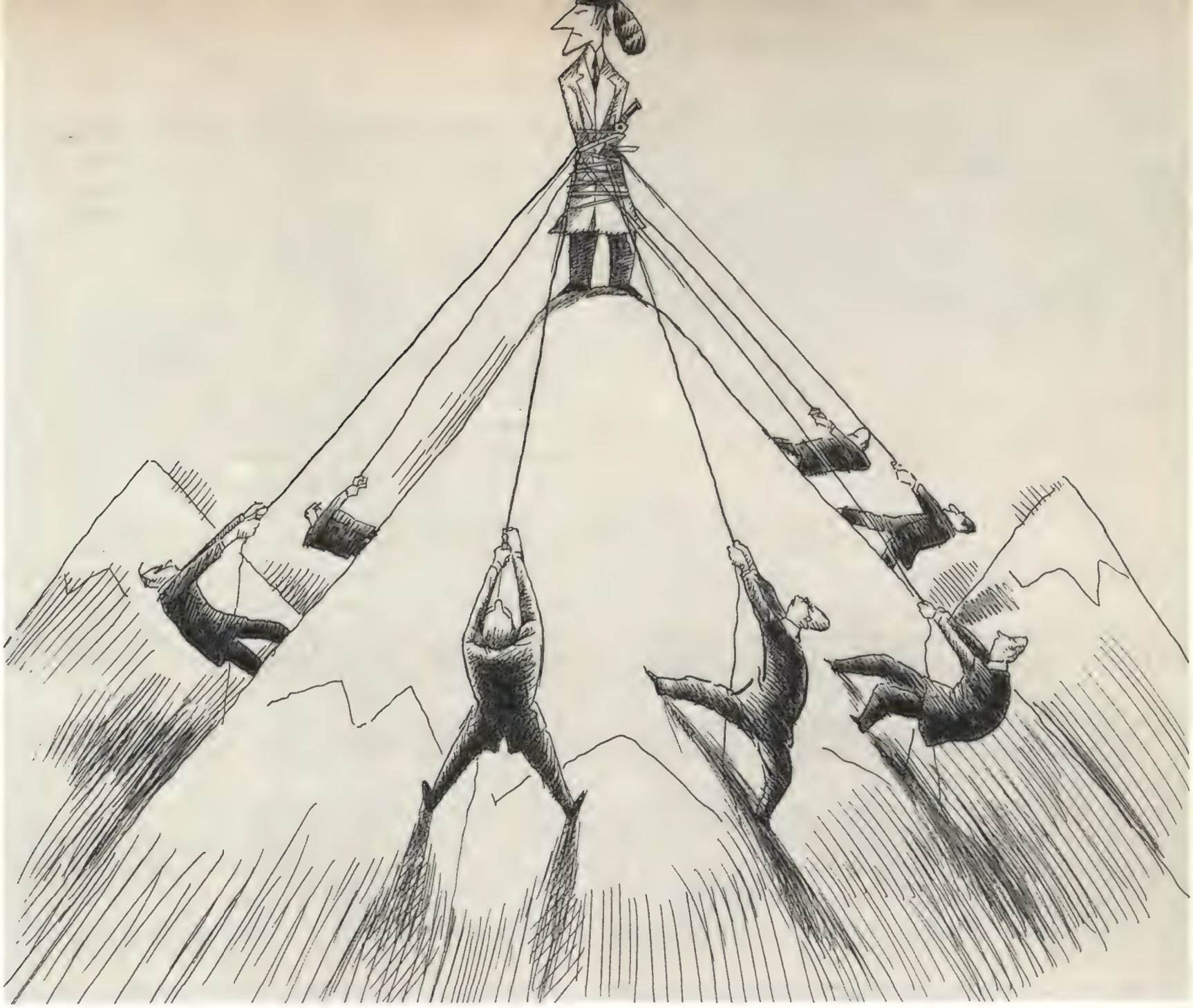
How confident can we be of this scenario? Very, because the changes are already taking place. The aspects of science and technology that we have been considering are governed by a powerful inertia; as we move into the last quarter of the century, the forces of change are gradually gathering momentum. Among people who feel that science and technology are at least as much a bane as a blessing, there is an axiom that says the products of research tend to take on a life of their own, that they almost inevitably spread through society and elude control. (Often cited as an example of this is the airplane, which, for the convenience of a few, creates a nuisance for the many.) What does not get much attention is the fact that in recent years some rather serious curbs have been applied. Decisions on technical projects have been increasingly made for political, economic or at least nontechnical reasons.

Consider the American effort to build a supersonic transport. Technically, it was a manageable task—as the Anglo-French and Soviet SSTs demonstrate. We could have done it, but we didn't. And the reason we didn't turn thousands of scientists, engineers, and technicians loose on the task was simply that Congress and the public concluded that the SST was a poor investment. So here we see politics and business determining that something that can be done should not be done. There have been other cases along these lines (drilling into the Earth's mantle, manned flight to Mars) and as the outsiders tighten their grip on science and technology, there will be more of them.

Politically out of bounds

Consider the case of nuclear explosives for peaceful earth-moving purposes. Known as Project Plowshare, the peaceful use of nuclear devices is described by advocates as a safe, highly economical and unmatchable technique for digging canals, moving mountains and loosening mineral and gas resources from deep inside the earth. Though a few small tests have been conducted, the method is politically taboo and is unlikely ever to come into large-scale use in the United States. This is not only because Plowshare runs the risk of releasing radioactivity in violation of the atmospheric nuclear test ban treaty to which the United States is a party; it is also because public fears of nuclear power are so extensive that no matter how great the benefits and minuscule the risks, peaceful explorations are—at least for now—politically out of bounds.

For another example of politics thwarting what is scientifically and technically doable, consider biological, or germ, warfare. Waging war with microorganisms is such a chancy business that both the United States and the Soviet Union probably felt they had little to lose when they formally renounced biological warfare under the Biological Weapons Convention



Beset on all sides by legislators, budget planners, lawyers, economists and anxious citizens who think they have him harnessed, the scientist's gaze remains fixed on the unregulated peaks beyond.

that went into effect last year. (The United States, in fact, gave it up unilaterally in 1969.) Prior to the renunciations, however, a large and amply supported community of biological warfare researchers filled a major Army laboratory at Fort Detrick, Maryland. As far as they were concerned, biological weapons merited a serious and continuing research effort, and there can be little doubt that if the decision had been left to them, they would still be at it.

These cases all involve the inhibition of science and technology by outside forces. What also must be considered is a relatively new, but rapidly expanding, process of the scientific and technical communities attempting to stay one step ahead of societal restraint by setting limitations for themselves. Last year, genetics researchers from several nations voluntarily agreed to an unprecedented moratorium; they were afraid certain gene transplantation experiments might result in highly dangerous disease-producing strains. The moratorium was partially lifted earlier this year following agreement on safety procedures and the development of microorganisms that are said to be unable to survive outside a controlled laboratory environment. The significance of this episode in voluntary scientific restraint cannot be exaggerated. For the principal figures in the story are all basic researchers, and, historically, if there is any basic tenet to basic science, it is that all of nature's secrets are fair game. The temporary moratorium did not conflict with that rule, but it did have the effect of delaying a good many research projects for social rather than scientific reasons. And that's something new in the life of science.

Along these lines, a blend of inside and outside concerns has produced uncertainty and turbulence over the use of human subjects in experimentation. The maze of regulations that has ensued from these concerns would astonish Dr. Walter Reed—just as they often astonish, and thwart, many of his scientific descendants today. What it all adds up to is that in response to pressures from the outside world, the sci-

Elusive indeed is the butterfly of research
and perilous its pursuit with flying microscope.

entific community is now seriously restricted when it wants to test pharmaceutical drugs and other substances on human beings, even when those human beings want to serve as test subjects.

Recommendations that are likely to have a profound effect on the conduct of research over coming decades are now being drafted by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The commission, which advises Congress and the Department of Health, Education and Welfare, has already provided the advice that the Secretary of HEW followed in changing rules for experimentation on fetuses. The moratorium on fetal research instituted by Congress in July 1974 was lifted in August 1975 after guidelines for the conduct of such research were tightened in response to commission recommendations. Now it is looking at the problems involved in experimenting on institutionalized mental patients, children and prisoners. One step ahead of the commission, however, the U.S. Bureau of Prisons has banned the use of prisoners in medical research on the grounds that the potential for abuse and manipulation is too great when a prisoner is invited to "volunteer" to take part in an experiment. The irony of it is that in testimony before the commission prisoners have insisted that they wish to retain the option to take part in experiments. They say they like the financial and psychological rewards that accompany participation. Drug researchers say that the ban will impede the development of valuable pharmaceuticals, since prisoners, living in environments where nutrition and other factors can be controlled, are ideal experimental subjects.

Many scientists support the new rules, but many others feel that society is clumsily imposing rules that will ultimately be to the detriment of society. All agree, however, that the days are gone when such matters were exclusively the business of science.

Today the federal government pays for about half of all the research and development performed in the United States. Over the first three decades of the postwar period, the amount of federal money for research and development grew so rapidly—from $918 million in 1946 to $24 billion in 1976—that it really was an era in which the doable usually stood a very good chance of getting done. This was a period in which the Air Force spent over $1 billion in a futile effort to construct a nuclear-powered airplane, oblivious of warnings that the weight of the shielding on the reactor would result in a plane that would be huge and slow, and of little military use. Because of the ever-present danger of a crash that would almost certainly spread radioactivity, the plane would not have been permitted to fly over populated areas. Nevertheless, more than a billion dollars was put into the venture and more would have followed if the Kennedy Administration had not stopped it in 1962.

From today's perspective, the striking aspect of the atomic aircraft project was that it got under way and flourished with virtually no public notice and scant congressional attention. Today, the scientific landscape in Washington is dotted with organizations that scrutinize research projects. Private organizations on the periphery of government, such as the Arms Control Association and the Federation of American Scientists, bring together prestigious scientists and engineers to examine the Defense Department's research programs and testify about them in Congress. Laden with Nobel laureates and former high-level officials of the department itself, they work in close alliance with the press and several-score congressmen and senators to throw light on weapons planning. Their main objective is arms control, which means they tend to be naysayers—definitely a minority position on military research and development. But their effect has been

Who will watch the watchers themselves and
under what microscope will it—can it—be done?

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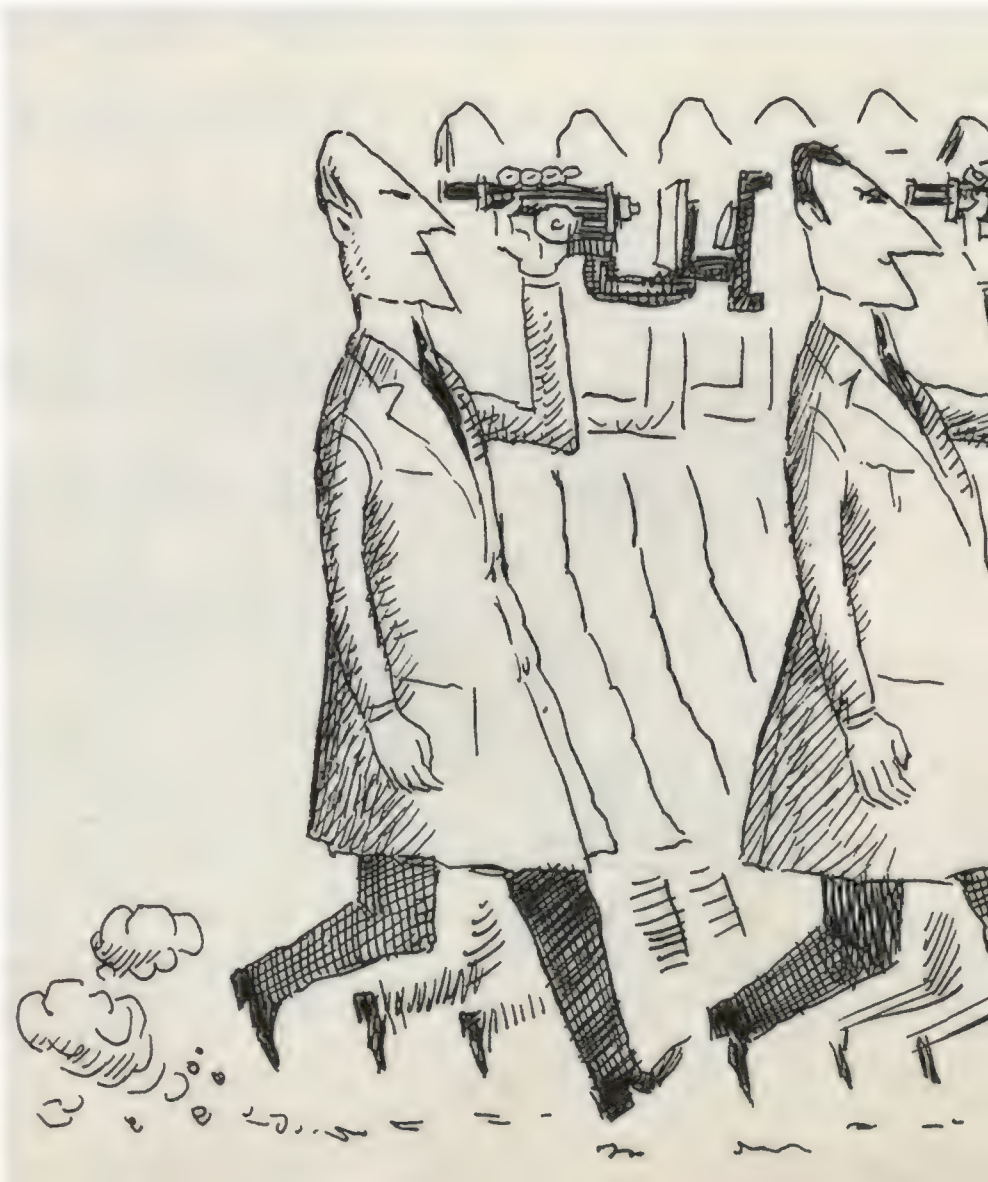
powerful in getting the issues out in the open and making the Defense Department less free-wheeling in its weapons programs. For example, the department has been trying for years to obtain funds for the production of a new type of poison gas projectile known as a "binary" in which two gases, nontoxic themselves, are joined to become a lethal weapon at the critical moment. Congress, mainly at the urgings of nongovernment critics of the weapon, has so far refused to put up the money.

The Congress itself has taken the unusual step of setting up its own organization, the Office of Technology Assessment, to attempt to look over the horizon and anticipate the impact of scientific and technological developments. OTA went into operation in 1974 and, though still a fledgling, has conducted a wide assortment of studies, ranging from the environmental effects of offshore drilling to the effectiveness of pharmaceutical drugs.

Meanwhile, government is increasingly relying on the use of impact statements to attempt to foresee the consequences of federal projects. The widest and best known use is in environmental matters. Before any federal agency can turn a spade of soil, it must now carefully analyze the cost effectiveness of its plans, the available alternatives and the environmental consequences. In effect, it must serve up reams of material that can be used by opponents of the project, which is one reason that the development of nuclear power in the United States is tied up in legal knots. The environmental impact statements have been cited in the court proceedings as evidence that the projects are unsafe, environmentally unsound or uneconomical.

In other nations, nuclear power plants are built where the nuclear power authorities choose to build them, with virtually no interference from dissenting parties. This process once prevailed in the United States, but today outsiders have a powerful say.

While the government's research programs have come under a variety of constraints, research conducted by private industry is also going through a transformation that is likely to extend for decades. Perhaps the most striking aspect of this transformation is that American industry—once the world's pioneer in innovation—has become extremely cautious about investing its money in research and development, so much so that some economists are expressing concern about where the new products will come from to spur the economy of the 1980s and 1990s. The increasing corporate timidity about research comes from a number of factors, among them the high costs and uncertainties of getting new products on the market, consumer conservatism in an inflationary period, and a tangle of government regulations concerning product safety. E. I. duPont de Nemours & Co., traditionally a pioneer in turning research into profitable products, typifies the new development. Irving S. Shapiro, chairman and chief executive of the giant chemical company, recently noted the changed attitude toward research projects when he said, "Where we had 24 a couple of years ago, I feel more comfortable with,



Rising above technology's proletariat may prove greatest challenge to tomorrow's scientists.

say, five or six." Other industrial executives say that their firms have concluded that it is safer and more profitable to refine existing products than it is to start from the ground up with new ones.

The effect of this caution is likely to spread throughout the entire research enterprise, starting with university training of scientists and engineers. If industry pulls back from innovation, its manpower requirements will have to be changed accordingly. With the academic job market already saturated and offering few employment opportunities for teachers, the trend is already toward warning prospective students that the future may be grim in many scientific and engineering specialties. Thus, a committee of the National Academy of Sciences last year recommended that university astronomy departments carefully advise interested students that the job market in astronomy has virtually collapsed. Even the medical profession is facing the possibility of saturation in some specialties; another Academy committee, studying the problem at the request of Congress, concluded that the United States has an oversupply of surgeons.

The maturing of the American scientific and technical communities has also been accompanied by several developments that would have been considered utterly remote just a decade ago. With employment opportunities declining and job security weakening, union membership is no longer a novelty among university scientists and engineers. Meanwhile, professional scientific societies have departed from their traditionally exclusive concern with substantive professional matters and have organized to protect their members' jobs. The American Chemical Society, for example, has established a legal defense fund to provide low-cost loans for members who feel their rights have been violated. The American Association for the Advancement of Science is in the process of encouraging its approximately 200 constituent societies to set up committees to protect the "scientific freedom and responsibility" of their members.

What, then, will the life of the scientific community be like in, say, 1998? My expectation is that it will be cautious in what it goes about researching; many possibilities will arise for researching this or that, but the final choices will be filtered through scrutiny processes that will examine costs, societal value, potential benefits and hazards. The researchers will enter the profession through a fine-screen selection process and their performance will be closely monitored. The situation is not likely to be favorable for late bloomers or innovators who need a decade to produce results.

The situation I foresee is not especially attractive in comparison with the frontier days of science. It is heavily organized, bureaucratized, reasonably productive, relatively safe and probably quite dull in its ultimate output.

The Albert Einsteins and Walter Reeds of the next turn of the century won't like it.

THE IS 100

The Liquid Phone—first telephone to carry the words of Alexander Graham Bell.

March 10, 1876: "Mr. Watson, come here—I want to see you!"

In the years since Alexander Graham Bell invented the telephone, it has progressed from a curiosity piece to an instrument people everywhere depend upon for their daily existence.

Here are some of the things that have made that progress possible.

February 6, 1882: Western Electric wins competition to manufacture phones for Bell.

In Boston, Anson Stager, Enos Barton, and Charles Scribner of the Western Electric Manufacturing Company met with Alexander Graham Bell to demonstrate a telephone they had built to Bell's specifications. Its quality was superior and convinced Bell to award Western Electric the contract to manufacture it.

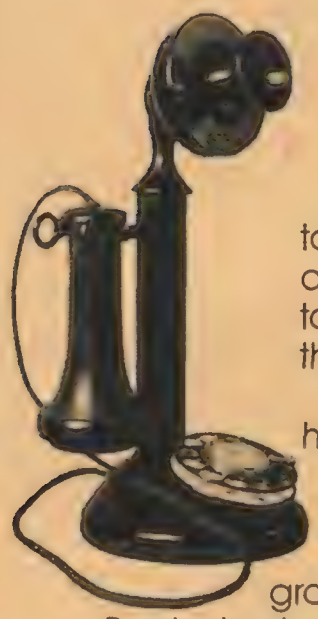
Western Electric became a partner in the growing Bell System. And today it still performs the same vital task it began 94 years ago: building the highest quality telephones, switchboards and connecting equipment at a reasonable cost.

June 17, 1914: Transcontinental telephone line is completed.

To a group of men near the town of Wendover on the Utah-Nevada border, it had been a grueling five-year project. They had installed 130,000 telephone poles, strung 13,600 miles of wire. They had endured summer days of 130° and weathered snowfalls so blinding even their pack animals were forced to wear dark glasses. It was an enormous task. But linking both coasts by telephone had been worth it.

When service began in January, 1915, a call from New York to San Francisco took 23 minutes to go through. The cost was $20.70. Today, a coast-to-coast call can be made in seconds for under a quarter.

TELEPHONE YEARS OLD.



November 8, 1919: Dial service begins.

In Norfolk, Virginia, Bell customers could do something they couldn't do before. They were able to pick up a telephone and dial their own calls.

In the past, operators had to connect each call by hand. But the operators, mostly young boys at first and then women, couldn't keep up with the growing number of calls.

Beginning in 1919, machines made dial service possible. With it, the telephone as we know it today was born.

April 7, 1927: First television transmission.

In New York, a handful of people were given a glimpse of the future. It was called television.

In this first demonstration in America, Herbert Hoover, then Secretary of Commerce, spoke from Washington, D.C. The picture was carried over telephone lines by a system developed at Bell Laboratories. It was only an experiment. And, at the time, few people realized just how successful it would turn out to be.

The Bell System is still deeply involved in television. In fact, the network shows you now enjoy come to you in much the same way as the first one in 1927—through the Bell System network.

December 10, 1956: The inventors of the transistor receive the Nobel Prize.

The men who were awarded the prize, John Bardeen, William Shockley and Walter H. Brattain of Bell Labs, had invented the transistor in 1947 to help improve telephone equipment.

In a thousand different ways, from push-button phones to satellite communications, it has done just that. But at the same time, it also helped make a whole new world of technology possible. In computers, modern radio and television, even man's conquest of space, the transistor has played a major role.

All of which raises an interesting question: what might the phone company think of next?

The Second Hundred Years.

To Alexander Graham Bell, the present was never quite good enough. It could always be improved upon.

At the Bell System we believe the same thing. We take great pride in the accomplishments of yesterday and today, but we're continually at work on the future. For example, even now we're starting Electronic Long Distance Switching—a computerized way to make long distance calling faster and more efficient than ever before. Further in the future, we'll have Lightwave Communications, a system that will carry phone calls on a beam of light.

Alexander Graham Bell invented the telephone to help people communicate better. Our goal is to keep improving on his dream.

We're keeping America's phone system the best in the world.

Bell System

Nigerien farmers fight a losing battle to keep up with mushrooming demand. How to feed a world population expected to double by the turn of the century is mankind's make-or-break question.

By Georg Borgstrom

The numbers force us into a world like none in history

Experience has not prepared us to understand the gravity of our food-and-people crisis. Coming years provide a last chance to solve it

"Population explosion" is a term familiar enough to screen the underlying reality from our mental view. Worse, however, it represents a philosophical error that hides the uniqueness of our present predicament. An explosion is a single isolated event, after which the survivors can pick up the pieces and build a better world. We are faced instead with a steadily mounting wave of people with no end in sight.

Humankind in this 20th century entered a new era to which our entire history has been a mere prelude. Most of that history took place in a world that had very little resemblance to the world we live in today.

At current growth rates, more than 75 million people are added to the human family every year. Every three years, more people are added than now live in the United States. Within six years the world will be faced with a new Europe in numbers; Asia alone is adding a new Japan every second year; Latin America, now the most rapidly growing area, is expected to add more than 350 million by the year 2000. Africa then will have surpassed Europe by 275 million.

The totals are alarming, too. Mankind did not reach its first billion until 1850. The number doubled in our own century, just 80 years later. Still accelerating, the population added its third billion in 30 years, in 1960, and its fourth in 15, just last March.

Demographers expect the world population to double between 1975 and 2000. That means that even if we somehow manage to double world production of food, minerals, housing and everything else, more

Villagers wait for food outside a church in India, a country overdeveloped in its human population.

people than ever would still be starving and malnourished. The hunger gap can be removed only by *trebling* food production during the next 25 years.

Planning for the future requires us to use different dimensions from those of the world in which we live. The huge irrigation dams, some serving millions of acres, rarely come close to providing food for more than a few years' growth of the population they serve. Most supply food to far fewer people than were added to the population during the construction period.

Innumerable undertakings in food production and processing are both commendable and even impressive, and yet fall terribly short of making any meaningful contribution to food availability. We are using entirely false yardsticks. Our measurements have not been gauged against reality.

The chief reason we as Americans and Westerners have failed to grasp the true realities is that two dimensions—the biological and the historical—have been missing from our image of the world. We have for too long been content to count heads and play the misleading numbers game of the statisticians, demographers and economists.

In biological terms, the true feeding burden of the planet is not 4 billion people, but rather 20 billion population equivalents (PEs): we must include livestock as well. A PE is a unit of protein intake; that of a human is one. The feeding population of the United States is 1.7 billion PEs, a number that includes 215 million human beings, 150 million pets, and livestock. The one billion more people the demographers expect in the next 13 years are really—in biological terms—five billion.

The historical dimension is even more important to understanding. Europe remains comparatively well fed because the greatest migration in human history eased the pressure on food production. Toward the middle of the 19th century, Europe was no longer able to feed its rapidly growing numbers, and so from 1850 to 1950 some 75 million people emigrated, with half of them going to North America, where 400 million acres were added to Man's cultivated domain. In his eight-millennia quest for food and feed, there was never another single event of such dimensions as the opening up of the North American continent to tillage and livestock. Western man also swarmed into other empty lands of the Western hemisphere and similar regions of Africa, Oceania and even Siberia.

In this way Europe disbursed a quarter of its population and was able to double its tilled land and treble its pastureland, thus temporarily resolving its food and population problems. By this grandiose transcendence of his limits, Western Man lost his awareness of the biological constraints of our globe.

After World War II the already well-fed nations seized still another part of the food producing globe: the oceans. This "last continent" was tapped by the Soviet Union, Japan and Europe, both East (led by Poland and East Germany) and West (led by Spain and France). Fish catches tripled in the third quarter of

this century, and the fishing nations prided themselves on far outstripping agriculture in the production race (the average annual increase in the catch from 1950 to 1975 was five percent). More than two-thirds of the catch ended up among the well-fed, with about a third being converted to meal and oil.

From whatever source, food remains the key to survival. Nowadays mortality rates are discussed in medical terms: vaccinations, antibiotics, antimalarial campaigns. The historical fact that access to food has been the primary determinant of population growth has been left out of sight. Nobody disputes that medical advances have contributed greatly to survival, but far more decisive is the degree to which it has been possible to feed those who have survived.

Today it is clear that the crucial aspects of the population issue are biological pressure on the planet's resources and the relationship of agricultural acreage (and water) to numbers of people, measured in protein and calorie intake.

During the third quarter of this century, overall global food production kept pace with the population growth. Sugar and fat production grew faster than the population, but legumes, a key supplement for the cereal-eating billions, lagged behind, resulting in a deteriorating nutritional situation. The overall gains took place mostly within the well-fed world; the hungry world barely managed to strike a balance. In Asia the increase rose briefly to seven percent, still shockingly low when compared to the 50 to 100 percent increase needed to fill existing nutritional needs.

Because of exorbitant animal production, each Westerner requires two to six times more grain per day than does his counterpart in the hungry world. Few developing countries could allow themselves to use so much of their tilled land to raise animal feed (82 percent in the United Kingdom, 62 percent in the United States). The well-fed world has three times as much tilled land to feed each individual as does the hungry world, and benefits additionally from being located in far more favorable climates.

Some European countries have as little land per capita as do Asian nations, but the European countries manage through trade and fisheries to depend on huge additional acreages, rarely recognized. As a consequence, these countries rate as highly as North America in tilled land per person.

Each American depends on an acre and a half of tilled land and another three acres of rangeland and pasture. In India and China, each citizen depends on a third to a half acre of tilled land, and in India only a token amount of pastureland (0.07 acre per inhabitant) remains. Despite expanding acreage in many developing countries, global trends show a continuing decline in tilled land per person.

A chief reason why the rich world has misjudged both the food and population issues is the degree to which it has directly or indirectly appropriated the world's food resources for its own use. Thanks to the enormous flow of food and feed from the entire globe, the rich world has not felt its own population pressure.

Europe now depends on an added continent in tilled land half as large as its own total of cultivated soil, equal in size to nine-tenths of South America's tilled land. About a third of this supporting area, or "ghost acreage" (up to 1972 it was half), is represented by ocean harvests. Japan has copied this pattern and depends on almost seven additional Japans, half oceanic.

Is either Europe or Japan aware of its immense reliance on distant lands and oceans? Do Europeans realize that their net importation of plant protein exceeds the total consumption of the Indian subcontinent? That it is a fifth more than that of Africa?

Has either the United Kingdom or Japan grasped

Dr. Borgstrom, a professor of food science and human nutrition and of geography at Michigan State University, wrote The Hungry Planet *and* Too Many.

This Ethiopian also has to provide for his livestock, a consumer frequently uncounted by the statisticians.

the fact that its importation of plant protein not only surpasses by far the combined annual purchases of cereals by India and China on the world market, but also actually equals two-thirds of the combined human consumption of these two giants? The globe cannot accommodate such huge extraterritorial survival bases for the billions of the poor world.

There are innumerable other indicators of the extravagance of the protein sanctuary—North America, Europe, the Soviet Union and Japan. Several European countries put more fish protein, some even more milk protein, into animal production than into human food, and import more plant protein as animal feed than their inhabitants consume directly.

United States soybean trade provides another blatant example. It has been touted as a major contribution to allaying world hunger. It could be, but less than five percent of this export of ours serves this purpose. The amount of protein moving into the world market as soybeans and soy meal could supplement adequately the diet of no less than one-and-a-half billion people. This is rarely taken into account.

Long-distance hauling over land and oceans is itself part of the problem. The urban millions have lost touch with their survival basis, visualizing imports only in trade figures of tons and dollars. The awareness of what it takes in land, water and storage to feed each person has, by and large, been dissipated in the euphoria of alleged technical and economic miracles.

It would be enlightening and sobering to supplement all such trade statistics with per capita figures, a kind of basic scrutiny relating food to people. Sometimes impressive tonnage figures become minor on a per capita basis, sometimes the reverse is true. Switching from absolute tonnage to relative poundage would put an end to any prevailing fallacies in the food-people debate. For example, the Caribbean and the Middle East are in such terms major cereal importers, and vying with several European countries for the top spots. They import some 250 to 500 pounds per person per year. Contrast this with about 15 pounds of wheat for each person in India and China. Only per capita figures convey a clear picture of the degree to which a country is transcending its limits and relying on external support.

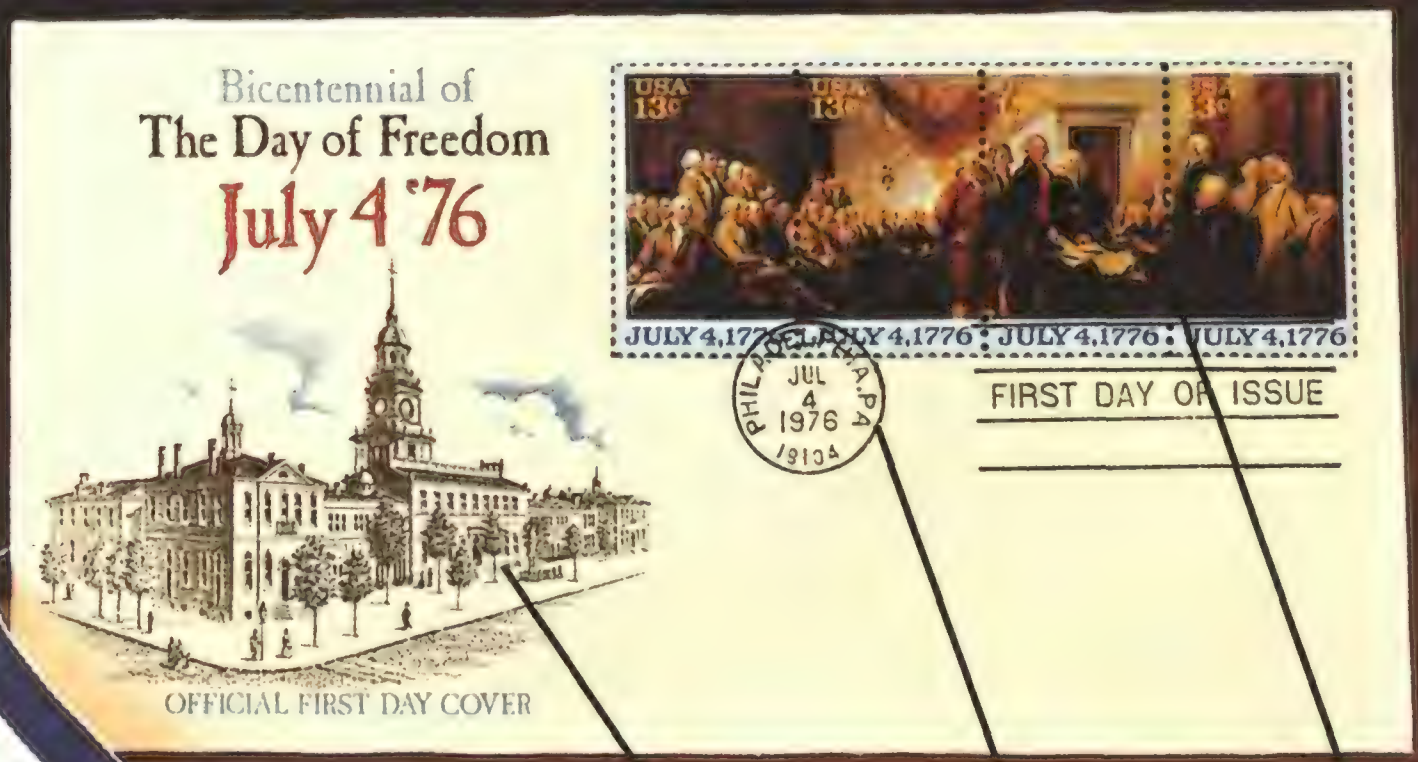
In the course of Man's quest for food, more than half the world's forest cover has vanished, large areas of grassland have been plowed, and major groundwater reserves irreversibly drawn down. China and India, the overfilled giants, have both paid a very high ecological price to provide for their millions. Forest and pasturelands have been squeezed down to wholly inadequate levels. Erosion, desertification, waterlogging and salination have destroyed much tilled land and are jeopardizing still more. Irrigation reservoirs are filling with silt at ten times the anticipated rate. Such problems are equally grave in numerous other countries that should be labeled biologically overdeveloped rather than designated underdeveloped.

Despite impressive postwar advances in yields per acre, 40 to 60 percent of the world food production increase has come from expanded acreage. To accommodate future billions, half of the now remaining forests will have to be cut down and much surviving grassland will give way to the plow. These prognostications jibe poorly with ambitious plans for expanded forest production, not least of all in the poor world, where 80 percent is used for firewood. Most of the remaining accessible forests lie in the humid tropical zone, on land poorly suited for intensive agriculture.

Doubling world food production, through added acreage, increased yield, or both, would require investments of more than a trillion dollars. Even then, most good land is already in use. The U.N. Food and

July 4 '76

Announcing the Official First Day Cover of the Bicentennial Day.



Shown reduced.
Actual Size:
7½" by 3⅞."

Official Cachet. Masterfully engraved by noted artist Richard Giegling, and imprinted by the intaglio process used for currency.

Official First Day of Issue Postmark. Certifying the first edition of our Nation's Bicentennial stamps. Only available July 4, 1976.

Official Bicentennial Stamps. To be *first* issued on July 4, 1976, only at the city where America's Freedom was proclaimed.

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On July 4th thousands of Americans, led by the President, will gather at Philadelphia to rededicate themselves to the abiding principles of the Declaration of Independence. It will be precisely 200 years since the day our Founding Fathers gave us the priceless legacy of Freedom.

As part of the impressive ceremonies that day, they will inaugurate Official First Day Covers . . . the *first*-editions . . . of our Nation's Official Bicentennial stamps. Stamps recapturing the moment America was born . . . the Declaration of Independence.

Appropriately, the Philadelphia '76 Commission will issue the Official First Day Cover of these inspiring stamps. Each officially-certified by the historic, one-day-only, *First Day of Issue* postmark available *only* on July 4, 1976, and *only* at Philadelphia.

Until July 31, 1976, subject to availability, you may reserve this Official First Day Cover for yourself and for your family. This is an important opportunity. Because of this issue's historic and patriotic value. And, because the stamps will *not* be available elsewhere until *after* July 4. Thus, only the *first edition* will be postmarked on the exact Bicentennial Day, July 4, 1976.

A handsome presentation album housing the engraved signatures of the 56 Signers of our noble Declaration will be included without additional charge to protect each Official First Day Cover (Limit: Five) you order. Postmark your order not later than July 31, 1976, and mail it directly to the world-renowned Fleetwood Company, 1 Unicover Center, Cheyenne, Wyoming 82008, which has been appointed by the Philadelphia '76 Commission to produce the Official First Day Cover and to process and fulfill all orders.

You, your children, and their children will forever be inspired by this historic commemorative. Reserve it today.

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July 4 '76

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Agriculture Organization maintains that investment can give reasonable returns only over the short term, in the form of higher yields.

Fertilizer use is growing faster than population. Of the farm output in the rich world, 40 to 50 percent is directly attributed to fertilizers. In the developing world more fertilizer is required to raise yields, so desperately needed, and to restore fertility to soil depleted through the centuries. In 1972-73, fertilizer use in North America amounted to 165 pounds per capita while in Africa the figure was 12, in Latin America 27, and in Asia (excluding Japan) 13 pounds.

The sheer bulk of fertilizer now transported across land and sea in a year's time exceeds the weight of the entire human family and is growing twice as fast. Producing and distributing fertilizer requires vast amounts of energy and money, both limiting factors.

Nitrogen, phosphate and potassium are the three primary nutrients plants need, yet far more nitrogen is being used than the other two, causing imbalances that disturb the natural processes of the soil. On a global scale, nitrogen fertilizers are rapidly reaching the point where they provide about one-third the amount that is naturally fixed in agricultural lands. This added nitrogen and the lack of phosphate, necessary to natural fixation, frequently stops the latter process, for which nature provides the energy.

When we think of food we generally take water for granted, but worldwide the water situation is worse than that of food: more than three billion of us do not have water of acceptable quantity or quality. Yet the affluent minority continues to increase its per capita use of water. Even in industrialized nations, food production is the top user of water. The diet of the rich world requires ten times more water to raise than that of the hungry world. In many parts of the world, the mining of groundwater has induced ground subsidence and water tables have fallen down to 1,000 to 2,000 feet. Such deep pumping, as well as large-scale irrigation, becomes unrealistic as energy costs mount.

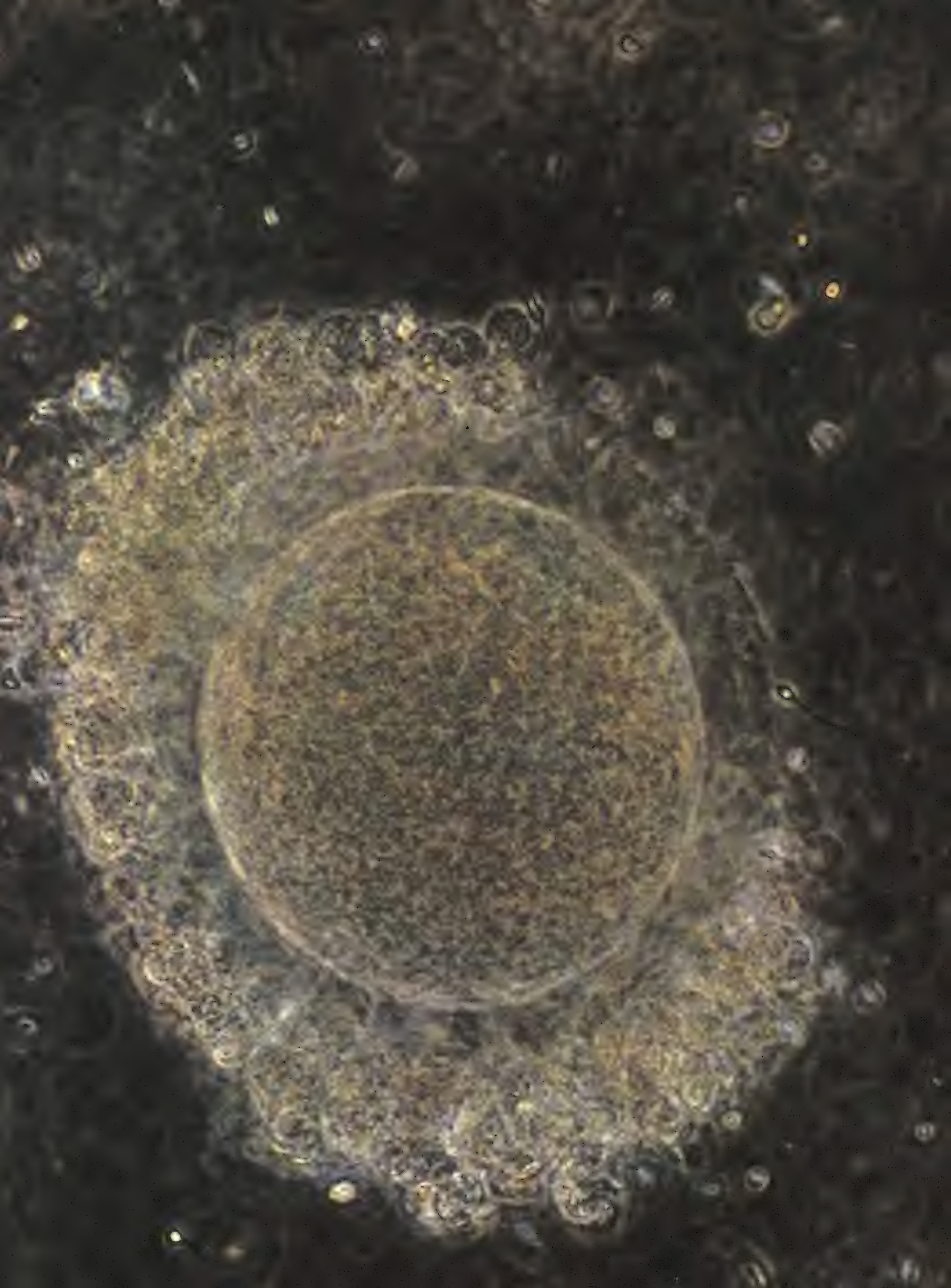
Balancing food, people and water is further complicated by the accelerating rural exodus to the cities—more than 600 million within the next ten years, with no less than 450 million in the poor world. This reshaping of society adds exorbitant distribution burdens to the food budget while placing huge regional demands on water. Yet both food and water are mostly taken for granted on the naive assumption that market forces will move in to assure them. Once again the biological dimension is out of focus.

Three mighty forces now on the world scene all deeply affect the food situation: population growth, escalating affluence, and growing numbers of destitute, landless and unemployed. Accelerating affluence and mounting poverty are equally disruptive. More food does not necessarily mean feeding more people; today, by and large, it means providing more for a shrinking but privileged minority both in the rich world and in a number of poor countries. Simultaneously, technology is increasingly making Man superfluous and creating unemployment. In the food field we base our programs on "effective demand," not on the true requirements of mankind.

On the whole we have been very clever tacticians but woefully negligent strategists. The terms ecology and economy both originate in the Greek word *oikos,* which simply means home. They must be balanced. Man's continued existence presupposes that economy is understood in its original sense: guidelines for rational utilization of nature's resources, based on a complete accounting, not on arbitrary selection of credit accounts. We must come up with a new ecosystem for ourselves, one that recognizes the basic need to recycle "wastes." Creation of a functional urban ecosphere stands out as one of our most urgent priorities.

Malthus placed before mankind the risks of war, pestilence and famine, if it did not pay attention to the growing imbalance between food and population. He urged his contemporaries to take the route of restraint. I would amplify on this by adding that we need to show restraint in all respects, not only in procreation. That is the only route that will assure the United States and the world an acceptable human condition in the next century. This, the 20th century, may well be the last one in which we still have the option between progress and disaster, of bringing chaos or order to Man's home.

Here, with the sperm (at right) penetrating a human ovum, is where the problem might be said to start.



Push buttons may summon everything from today's TV fare to a university course or income tax form.

By Erik Barnouw

So you think TV is hot stuff? Just you wait

Developments in telecommunications point the way to a wired world with no need for commuting or shopping at supermarket

Don't look now, but your television set is about to be replaced by something more up-to-date. As with many giant steps in technology, it will involve ideas that science-fiction people have been picturing for decades—in fact, for a century or so. Now, at last, in diverse laboratories and field tests, their visions are turning into practical hardware. The ingredients seem to be right at our hands.

Your television set, your stereo, your telephone are really quite primitive—"tom-toms" compared to what is now possible and inevitable, according to Peter C. Goldmark, the far-sighted retired chief of CBS Laboratories, responsible for many electronic breakthroughs.

A factor behind the euphoria is a development relating to cable television. This system has long been able to deliver 20 channels or more—a versatility impossible to over-the-air television—so far not at a sensational profit. Now it is about to be expanded further, in a fashion: it may soon offer a choice of hundreds of channels, along with another dramatic option—two-way communication, the chance to talk back.

The key to all this is a mysterious "optical fiber," now emerging from the laboratory. This glass fiber looks like a thin violin string. Laser beams can travel through it and — incredibly — carry innumerable streams of communication simultaneously in both directions. Combine this virtuosity with various "miracles" already familiar to us—computers, satellites, cassettes, facsimile transmission—and what do you have? A "telecommunications" revolution, it would seem. What its social implications may be, is not clear. To Goldmark, it will be a momentous "democratizing" development, involving an unprecedented government-citizen dialogue. Others see it as opening a new era in education. Still others see it as a breakthrough for minority interests of all sorts, offering them a diversity of special channels.

There are also less optimistic opinions, but problems of use, in the view of most telecommunications technicians, are for later. They themselves are developing the "hardware." "Software" problems can be settled in due time by writers, teachers, performers, producers, graphic artists, musicians and so on—the software people, as they are known in telecommunications language. (Software people don't seem to care for this term. In fact, hardware and software people tend to be kept apart by their vocabularies. But let us set this problem aside and see what the hardware people have in mind.)

It goes like this. In one wall of your room will be a telescreen. It will be able to bring you a wide range of images and sounds and data, via push-button controls. In the first place, you can summon up current events, drama offerings, game shows, athletic contests—not unlike your current television choices. But you may also decide to see a classic film which a computerized switching system can call forth from an archive. Or you may decide to take a university course, prepared and stored in an electronic repository; each lesson, as and when you need it, can be summoned by your push buttons. When ready, you can order the exam: question after question will appear on your telescreen, to be answered by push button, and the sequence will be climaxed by your grade, which will at once be recorded somewhere in a data bank.

For intensive study you may want some information on paper rather than on the screen. Pushing the right buttons, you can bring it spilling out in the form of a "printout." Your income tax forms may reach you in the same way—unless that primitive business is abolished for an entirely new system, to be mentioned presently. Your daily newspapers may also reach you in this way.

Instead of conversing with a computer you may prefer to talk to a human being—your daughter in St. Louis, for example. There seems no reason why the telephone function, including sight, should not be incorporated in the telecommunications system. Thus you and your daughter will be able to speak to each other while each appears on the other's screen. For con-

Erik Barnouw, long-time professor of dramatic arts at Columbia, is now a Woodrow Wilson Scholar at the Smithsonian. He is author of Tube of Plenty: The Evolution of American Television *(Oxford).*

Drawings by John Huehnergarth

ference calls, split-screen arrangements can be used, so that face-to-face business conferences can involve representatives of widely scattered offices, even on several continents. Much business work can be done at home, with instructions, reports and statistics transmitted electronically—via words or visual display or printout, or a combination of them. The insanity of rush-hour travel may gradually pass into history.

One of the most irrational of modern logjams, the postal system, may also yield to tomorrow's telecommunications. The telescreen engineer sees every home or office as a "terminal." The well-equipped terminal of the future will be able to send, as well as receive, official documents and letters.

It is assumed by most telecommunications futurists that some of the choices available via your push-button (digital) controls will be free—sponsored by advertisers or available as a government service—while others will involve payment. Tuning to an opera performance will probably involve a fee. For a university course you will likewise be charged something, corresponding to current tuition fees. The method of payment will probably be made as painless as possible. The act of tuning may simply deduct the fee electronically from your bank balance. Perhaps, as you tune, an appropriate WARNING will appear on your screen—like the highway phrase, LAST EXIT BEFORE TOLL.

One of the forces propelling telecommunications toward a new era is the computer. Data banks are already, of course, a reality for insurance firms, banks, law enforcement agencies, health agencies; access to such data banks is available over long distances via cable or microwave or satellite. A Milwaukee hospital, about to perform an emergency operation on a patient from Los Angeles, can get the patient's computer-stored medical history in seconds. A new Orleans newspaper, instead of trying to maintain its own massive newsclipping "morgue" on international events, can purchase access to the *New York Times* computerized morgue or information bank. An FBI agent investigating a case in Albuquerque can instantly check fingerprints and other data in Washington computers. One computer can feed its data to another. In telecommunications scenarios, computers are constantly talking to each other.

In all such communication transactions, the term long distance is losing much of its meaning. When television programs or documents or data are transmitted by satellite, 3,000 miles involve no greater difficulty than 300 miles. In phone calls of the future, with two-way video in color, distance may no longer be a cost factor.

Thus the ingredients of the revolution are with us; their wider use seems certain to affect home and office, business and pleasure, information and persuasion, student and teacher, citizen and government, in ways that may be startling. Optical glass fiber is based on cheap and plentiful silicon, whereas coaxial cables use scarce, expensive copper. The difference may hasten the wiring of communities throughout the world. What the scientist foresees is that the virtuosity of the fibers, combined with that of satellites and computers and electronic recorders, will tend to integrate various communication systems and purposes into an extraordinary multichannel, interactive communications world: communication of one to one, one to many, many to one, many to many.

Can future hardware needs be met?

So confident are scientists of this development that intensive meetings have already been held to work out details, to anticipate what hardware may be needed. Meetings have been held in the United States under the auspices of the National Research Council, sponsored by a consortium of government departments—Commerce; Health, Education and Welfare; Housing and Urban Development; Transportation—with participation by representatives of the Federal Communications Commission, the U.S. Postal Service, and the White House Office of Telecommunications Policy. All feel that the impending communications revolution may radically alter the context of their work. And all look to the revolution for answers to their increasingly pressing problems.

The scientists brought together in such meetings are from diverse fields, representing television, telephone, telegraph, aerospace, computer and other industries. They see their interests converging—but also clashing. Thus the emerging telecommunications visions involve a power struggle, which will be, in fact, a continuation of struggles almost as old as the Republic.

Wiring of the world began with the telegraph;
later the telephone became all-powerful.

The wiring of the world really began with telegraphy. In the United States this invention was soon seen to offer, along with rich blessings, some dangers. "What hath God wrought?" Samuel Morse had asked, clicking the first intercity message. For a time the answer seemed to be: monopoly power.

By the 1870s Western Union, absorbing smaller companies, had a web of wires reaching 37 states and nine territories. As the only such system, it could charge monopoly rates, but its leadership found other—and more lucrative—keys to wealth and power. Representative Charles A. Sumner of California charged in 1875 that sudden changes in market prices were repeatedly withheld from San Francisco until insiders had made a killing. Control of the flow of information could yield bonanzas.

With the invention of the telephone by Alexander Graham Bell in 1876, the monopoly position of the telegraph began to suffer erosion: information acquired an alternative channel. Western Union tried to throttle the competition with patent litigation, but failed to do so.

By the 1900s AT&T (American Telephone and Telegraph) was so wealthy that it could, with one $30 million check, buy control of Western Union. But by this time the nation had learned something of the dangers of monopoly control, especially in communications, and the sale was halted by antitrust action. The two wire systems remained as competitive elements, along with another rival, Postal Telegraph. This was a private company, formed in 1882, having nothing to do with the postal system; it simply decided to call itself "postal" because the word had become an antimonopoly rallying cry. The company became especially active in communications abroad, and these activities eventually metamorphosed into ITT (International Telephone and Telegraph Corporation).

Early inventions shrink the world

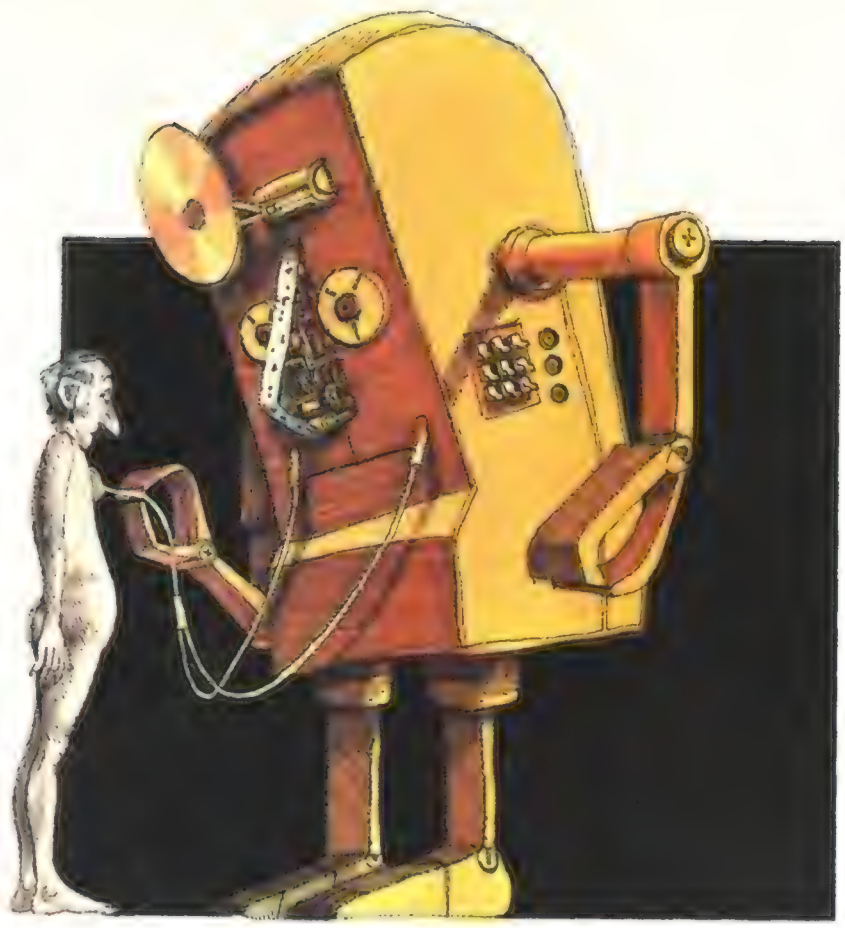
Meanwhile, still another information channel had made an appearance: wireless, which became radio, which gave birth to electronics, which in turn bred the computer. In the laboratory, Edison's electric lightbulb turned into the electronic vacuum tube, and this helped lightbulb manufacturers such as General Electric, Westinghouse, and Western Electric (an AT&T subsidiary) to assume gigantic stature in electronics and radio.

During World War I their assembly lines produced quantities of electronic war material. The war dramatized the unique abilities of radio as a communications instrument, and this led in 1919 to formation of RCA (the Radio Corporation of America)—in which General Electric, Westinghouse and AT&T became controlling partners. Again a dangerous communications monopoly seemed to be forming, but antitrust pressures eventually dissolved the partnership, and made RCA independent of its creators.

Although RCA was organized as an international message service, its energies were soon redirected by the eruption of the broadcasting mania, which between 1920 and 1922 brought more than 500 stations to the air in the United States.

For a short time, all broadcasting stations performed independently, producing their own programs—a clearly irrational arrangement. Stations could be linked into networks by the use of connecting wires. AT&T, Western Union and Postal Telegraph all vied for this interconnection role. AT&T won the struggle. With the formation of NBC in 1926 and of CBS in 1927, AT&T became their sole means of interconnection. Some observers thought this posed the danger of a new power concentration, but once again a new element was to alter the situation.

With the dawn of the space age after World War II, the communication satellite emerged as an alternative



"Telemedicine" means the return of house calls through the telecommunications system.

means of interconnecting radio and television stations, as well as cable television systems, computer networks and other such systems. This brought the name Western Union back into the interconnection sweepstakes: by 1976 the Public Broadcasting Service was contracting with Western Union International for satellite interconnection to replace or supplement AT&T cables. And ITT had reentered the situation when it joined with RCA, AT&T and Western Union International in the formation of COMSAT (the Communications Satellite Corporation), to provide the world with international linkages.

All these, along with aerospace and computer interests, are behind the telecommunications visions in laboratory, think tank and seminar. They are coplanners, but also rivals.

Who will be the gatekeepers of the evolving system? Will authority be dispersed, or concentrated? Will the multiplicity of channels provide a rich diversity of choice, or only seem to? Who will decide what treasures are to be stored in the electronic archives available to your push buttons? Our whole history teaches us that these are crucial questions. More recent history confronts us with still further questions. Will the right of privacy survive the telecommunications revolution and its network of data banks? For the moment such questions remain unanswered, and unanswerable. The current focus is on hardware miracles.

Meanwhile, dreams of things to come lure us on. They offer a heady mixture of possibilities. Ithiel de Sola Pool of the Massachusetts Institute of Technology points out that nowadays an average family, settling down for an evening, generally has three television network programs to choose from. This has been, he feels, "a powerful force toward conformity. Wherever one goes in the United States, the same fads, the same styles, the same scandal of the week, the same ball scores, the same entertainments are on people's lips." He feels that in contrast the emerging technology can then help to "individualize people rather than to homogenize them."

He predicts: "Increasingly, communications devices will be adapted to individualized use by the consumer where and when he wants, on his own, without the cooperation of others; he will use machines as an extension of his own capabilities and personality, talking and listening worldwide, picking up whatever information he wants."

Pool apparently feels that Man himself will be changed by the emerging technology. "For the computer promises to make it possible to interrogate an inanimate data base with the same ease and success with which we now ask questions of a friend or colleague. . . ." He sums up: "A picture begins to emerge of a society ever more individualized in its interests and tastes."

The added factor of two-way "interactive" communication seems invaluable to Pool, as to others. Replacing an era in which "the citizen hears but is not heard," they see an era of citizen feedback. The economist Harold J. Barnett feels this factor will be especially important to local politics, restoring the "community ethos" which mass-audience television has helped to undermine. The factor is also considered important in

"telemedicine,"a subject of endless futuristic scenarios. These picture the physician examining and interviewing remote patients via telecommunications. A patient need not be brought to the electrocardiagraph: the telecommunications system can provide the link.

The two-way factor will also be important in the use of special shoppers' channels. The buyer at home will be able to survey available merchandise, then place orders and authorize payments.

The possible impact of telecommunications on finance is particularly intriguing. The financial world is drowned in waves of paper—currency, checks, stocks, bonds, bills, orders, accounts—that flow endlessly from office to office via messenger or the postal system. That all this is obsolete is being shown by computer networks. "Computers and wire," writes Barnett, "are moving us to a cashless society." Payments will flow over the telecommunications system. In the computerized financial world, taxation may even be simplified by diverting to the government small fractions of all individual transactions.

In the magazine *Science*, Edwin B. Parker and Donald A. Dunn describe the system of the future as a "combined library, newspaper, mail-order catalog, post office, classroom, and theater." It will resemble current television, yet change it radically. "Broadcast television is like the passenger railroad, taking people to scheduled places at scheduled times." Tomorrow's wired system is expected to be "like a highway network, permitting people to use their television sets in the way they use their personal automobiles; they may be able to select information, education, and entertainment at times and places of their own choosing." This will presumably foster "equal social opportunity in the United States."

Early radio with its growing networks was seen as opening a bright future for listeners.

We should recognize that new technology readily evokes rosy expectations. Possible blessings are more easily glimpsed than problems, and are more gratifying to contemplate. As we have seen, visions of the wired world have been with us ever since the invention of the telephone. As early as 1882, an artist pictured a woman shopping via television, and another taking a course via television. In the early 1900s, the motion picture was expected to have many of the same effects predicted for telecommunications—wide dispersal of knowledge, equalization of opportunity, strengthening of democracy and of international understanding. Broadcasting, at the very hour of its birth, was expected to have similar effects. The first issue of *Radio Broadcast*, launched early in 1922, predicted that broadcasting would

> . . . elicit a new national loyalty and produce a more contented citizenry. . . .
>
> . . . the government will be a living thing to its citizens instead of an abstract and unseen force. . . .
>
> . . . at last we may have covenants literally openly arrived at. . . .
>
> . . . elected representatives will not be able to evade their responsibility to those constituents who put them in office. . . .
>
> . . . the people's University of the Air will have a greater student body than all the rest of our universities put together. . . .

That same year a former Secretary of the Navy, Josephus Daniels, joined in the sanguine predictions: "Nobody now fears that a Japanese fleet could deal an unexpected blow on our Pacific possessions. . . . Radio makes surprises impossible." Magazine articles of the day featured such titles as "How Radio is Remaking the World" and "Radio, the Modern Peace Dove" and "Ether Waves vs. Crime Waves."

Telecommunication may improve our lives

Were they wrong, or are some of these predictions only premature and about to come true in a new "telecommunications" phase of the electronic epoch?

In the already large and growing literature on the wired world of tomorrow, a persistent theme relates to transportation. For it is expected that "message movement" will eventually replace much "people movement"—thus relieving our glutted transportation system, easing problems of the use of energy and improving the quality of our air.

Again and again we are told that the "symbolic interchange" offered by telecommunications can and must replace a large percentage "of the physical en-

Plugging into a satellite allows long-distance communication at no great rise in cost.

People will be able to converse with data banks as easily as they do with one another.

counters now serviced by physical travel." We will become telecommuters, teleshoppers and televoters. In the view of Dr. Gerhard J. Hanneman of the Annenberg School of Communication, University of Southern California, all this can lead to a more rational distribution of the population and ease the current pollution crisis.

But what will all those people be doing—those human beings who no longer need to stir from home, who will save endless hours of mass transport and be blessed with leisure? What will they do with their lives? What will their lives mean to them?

At this point, the hardware man invokes the software people. *They* are to enrich the citizen's life with a vast assortment of video services and packages: entertainment, education, art, culture. But the software man tends to be baffled by the assignment.

It seems to software people that the hardware specialist loves smoothly functioning equipment but does not love people, who are messy and disorganized. Why else would he devise these scenarios which always seem to eliminate people—or at least keep them out of the way, at home?

The root of all art is the fantasizing characteristic of human beings, by which they cope with the pressures and perplexities of their lives. Art serves the artist—and the audience, when art succeeds—as interpretation, clarification, redemption. What pressures will haunt the telecommunications viewer of tomorrow? What fantasies from the studios of software will fruitfully engage his attention, ease his tensions, keep him content before the telescreen and push buttons? The hardware emerging from our laboratories is truly miraculous. Designing the software may prove to be far more difficult.

Will there perhaps be a special channel for "approved revolutionary activities"?

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By Maya Pines

Genetic profiles will put our health in our own hands

Doctors soon will be able to recognize our inherited weaknesses and advise a life-style designed to minimize the risks

Strands of DNA twist in a crystal ball. Our genes can tell us what may lie in our medical future.

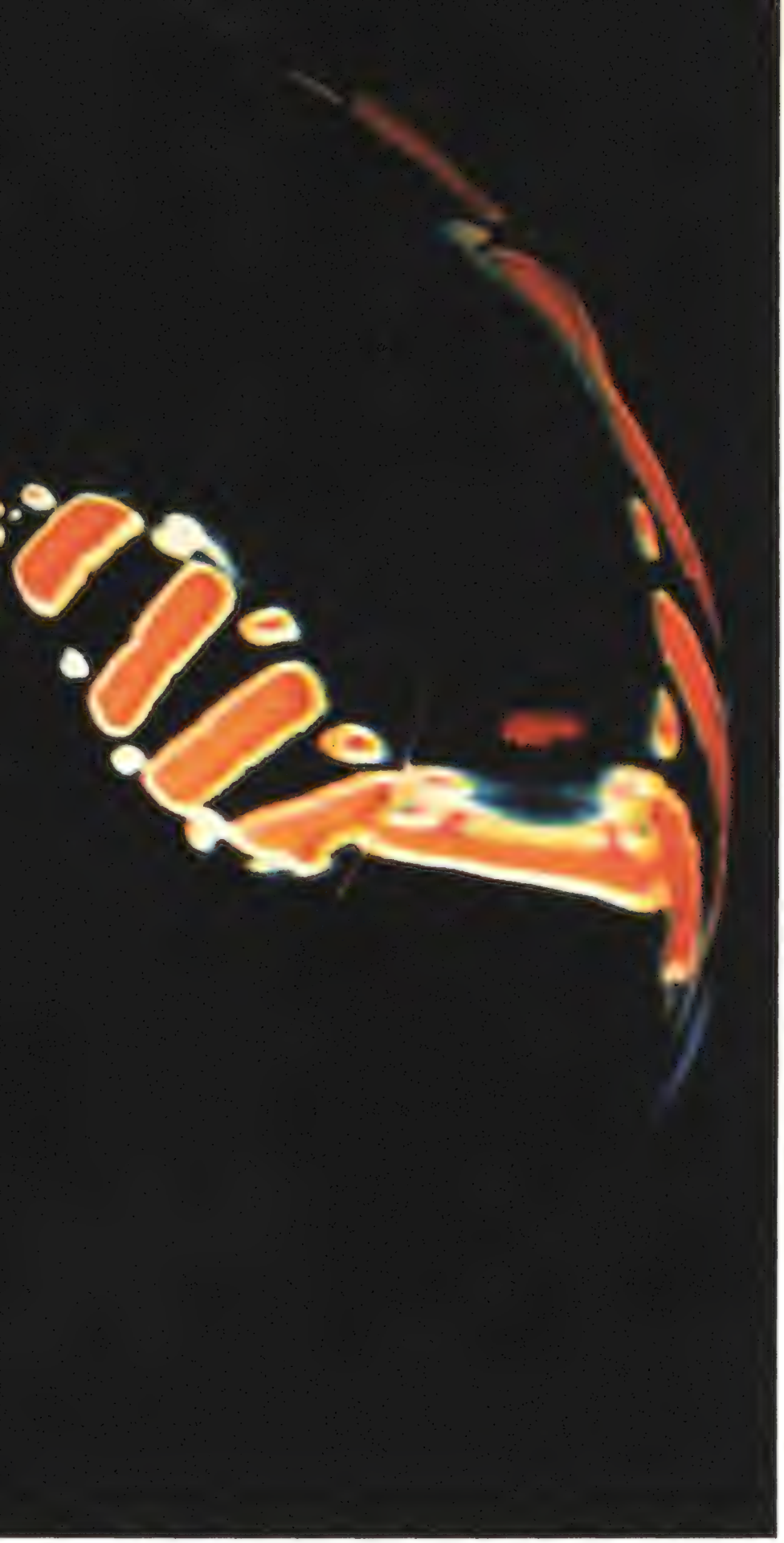
She was 19 years old and in perfect health. But her 22-year-old sister had just had a breast removed because of cancer. An older sister had also developed breast cancer at an unusually early age. So had her mother, as well as her grandmother and several aunts and cousins.

With this familial predisposition to breast cancer, the young woman's own chances of developing the disease were as high as 50 percent, according to the internist-geneticist who was called in as a consultant on her case, Dr. Henry T. Lynch, chairman of the department of preventive medicine at the Creighton University School of Medicine in Omaha, Nebraska. Such cancers often spread to the lymph nodes and to other parts of the body before they can be detected, with possibly fatal results. To spare her this risk, Dr. Lynch recommended that she consider preventive surgery even though she still had no sign of the disease. Involved would be the removal of tissue under the skin of both breasts in such a way that minimum scarring would take place and a nearly natural appearance could be maintained by replacement of the tissue with synthetic implant material.

Extreme? Perhaps. Most doctors would limit themselves to keeping close watch on such a patient, giving her annual mammography (a sophisticated x-ray examination of the breast) and thermography (a heat-measuring technique for diagnosing abnormal tissue), hoping to detect any cancer before it had spread. Nevertheless, this is the kind of confrontation with our genetic destiny that we may all come to expect in some form as a result of growing knowledge about the inherited factors which predispose us to specific diseases.

In most cases our confrontations need not be so dramatic. Our choices will not involve surgery, but only a change in life-style. Yet even these decisions will require a deep commitment, for we will have to stick to them throughout a lifetime.

The new science of predictive medicine will make clearer the alternatives before us by pointing out who



is at greatest risk for what. Until now, for instance, smokers have been able to shrug off the warnings about lung cancer because they could always assume that the statistics would apply to someone else. But researchers are examining some hereditary factors measurable in blood that may control the rate at which benzopyrene, a hydrocarbon in smoke, is transformed into a cancer-causing substance in the body.

"The research looks quite exciting and promising," says Dr. Harry V. Gelboin, chief of the chemistry branch of the National Cancer Institute. Eventually, he hopes, it will explain why certain smokers develop lung cancer while others, who consume just as many or more cigarettes, do not. Doctors will then be able to identify the two groups—those who smoke with less risk and those for whom smoking may be lethal. Once he learns that the "finger of fate" is pointing directly at him and that his penalty for smoking might almost certainly be death from lung cancer, even the stubbornest smoker in the cancer-prone group will be under some compulsion to stop. Better yet, such tests might be administered in early childhood, warning some children never to take up smoking at all.

Other tests could provide members of a diabetic's family with a better estimate of their own risk of developing the disease. Although it has been known for a long time that adult diabetes runs in families, the true extent of the risk to any family member has never been clear, according to Dr. Melvin Blecher, a Georgetown University researcher who is working to develop a sophisticated biochemical test of such risk.

If one of your grandparents is a diabetic, your chances of developing the disease in middle age are about 20 percent—nearly three times greater than average, but still not too alarming, he explains. With closer relatives being diabetic—a parent and a sibling—your odds are raised to 50 percent. But in a few years, if a recently discovered biochemical defect in blood cells proves predictive, reacting positively to Dr. Blecher's test will be a warning that you are nearly certain to get the disease—unless you take radical steps to avoid it. This means stringent controls over your diet: no sugar, few starches and a grand total of calories low enough to keep you slim, since even a 15 percent increase over your recommended weight could trigger the illness.

Normally this kind of discipline might be too much to expect, but "knowing that you are genetically marked for diabetes, it's worth the trauma of a restricted diet to avoid it," says Dr. Blecher. "It gives you a chance to control your own life." The test could also serve as a warning for people with this defect not to neglect any viral infections and to check into a hospital, if necessary, for better care, because the stress of a massive infection can sometimes produce outright diabetes among people who are predisposed to it.

Genetic markers of this sort are likely to be discovered for most of the illnesses that afflict human beings. Doctors will then be able to take on a new role, as scientific fortune-tellers. Peering into complex reports

Maya Pines, who frequently writes on medicine, science and psychology, has written a book on another medical frontier, The Brain Changers.

Photographs by Peter Angelo Simon

A family peers into the future, determined in part by the family tree in which they are entwined.

about the characteristics of our blood and skin cells, the production of certain enzymes, the constellation of our genes, they will be able to issue authoritative horoscopes. Each of us might then be given a genetic profile, listing our particular strengths and susceptibilities (for example: diabetes, high risk; lung cancer, less-than-average risk; atherosclerosis, average risk), together with individual guidelines as to what to do and what to avoid for the rest of our lives.

"I'm convinced everyone will have one of these profiles in the future," declares Dr. Fred H. Bergmann, director of the genetics program of the National Institute of General Medical Sciences in Bethesda, Maryland. A basic profile may be issued for each baby at birth, but it will need updating and expanding as the child grows up and more precise tests come out of the research labs. "What with our increasing mobility, this brings up the problem of records," notes Dr. Bergmann. "How can you possibly keep track of all the necessary information about every family? We may have to have this computerized, and people aren't going to like that at all because it raises the image of Big Brother."

Nevertheless, he believes that the information which can be made available through such profiles will prove far too valuable to ignore. If you are genetically marked for lung cancer, for example, it is helpful to know that the strictest diet won't save you, but that staying away from cigarettes might spare you a horrible death. Similarly, if you are marked for diabetes, there is no point in exerting willpower on quitting cigarettes when the true villain, for you, is sweets.

Some of the self-denials that may result from these profiles will be rather odd, though useful. If you find out that you are one of the estimated 100 million persons around the world whose cells do not manufacture enough of the enzyme G6PD (glucose-6-phosphate-dehydrogenase), for instance, you will do well to stay away from the commonest of all drugs, aspirin, as well as from certain antimalarials, the sulfa drugs, vitamin K, and a few specific products such as mothballs. Any one of these chemicals could make you severely ill. Since you are unlikely to have a great passion for mothballs, this is an example of predictive medicine at its best: the patient is forewarned and forearmed, with little hardship involved.

But how would you feel if you were suddenly issued a genetic profile which showed that within a few years you would almost certainly develop a totally incapacitating and eventually fatal disease? How much do you really want to know about your own future? Will the truth set you free to make wiser decisions—or might it paralyze you through loss of hope?

These are the questions which the science of predictive medicine will have to tackle with respect to illnesses that can neither be prevented nor cured. Unfortunately, such illnesses still exist. Most of them develop fairly late in life. Huntington's disease, for instance, doesn't generally make itself known until the victim is 35 to 45 years old—well after he has had children of his own, to whom he may have transmitted the disease. Since it is caused by a dominant gene, a child of an afflicted parent stands a 50 percent chance of developing it, too. The illness begins with a change of

Disease strikes the father, a disease to which his personality and with involuntary movements of the face, hands and shoulders (it was formerly called "chorea," from the Greek word for dance). Facial expressions become distorted. The speech is blurred. As the disease advances, the victim loses control over his movements and becomes irrational. It is a relentless process, culminating in death within 10 to 15 years.

In 1972 a Chicago researcher, Dr. Harold L. Klawans, devised a test that *may* predict which relatives of people with Huntington's disease will also fall victim to it. He knew that the drug L-dopa can sometimes produce something like a chorea in patients who are given too much of it for the treatment of another illness, Parkinson's disease. This chorea is temporary, however, stopping as soon as the dose of L-dopa is reduced. L-dopa also increases the tics and grimaces of people who already have Huntington's disease. Klawans wondered whether the drug would produce a temporary chorea among the most susceptible relatives of Huntington's disease patients—presumably those who would later develop the disease. Working in conjunction with Drs. André Barbeau and George Paulson, he gave some L-dopa to 28 relatives of people who had Huntington's disease and to an equal number of persons with no family history of it. Ten of the relatives began to display signs of the disease—signs which disappeared as soon as the drug was withdrawn. Meanwhile, none of the people in the other group showed any response to the drug.

Rumors soon began to fly. It was said that one of the persons who discovered he was doomed to get the disease committed suicide. Other rumors had it that Dr. Klawans now realized the folly of what he had done and stopped all tests. But none of it was true. To begin with, the test he used has not yet been proved accurate, Dr. Klawans points out; it may take up to 20 years to find out whether the people who reacted to L-dopa will, in fact, develop Huntington's disease or, more importantly, whether those who did *not* develop chorea while on L-dopa will be spared. This is why he has chosen not to use it on anyone else. Secondly, everyone who participated in the project was screened for emotional stability, and only one of the ten persons who developed the ominous reactions had any "significant psychological difficulties" as a result, according to Dr. Klawans. Nobody committed suicide, he says, despite one attempt. All too aware of the rumors, he adds that "I've even heard all of them committed suicide—which, of course, would make it very difficult to evaluate the test."

So far, nothing has contradicted the original observations. Attempts are being made to follow up both groups. Assuming that the test proves accurate and that no treatment for the disease exists, should the test be used at all?

"Yes," says Dr. Klawans, "I think I would use it, but only for a specific purpose: when young couples want to know whether or not they should have children. Huntington's is a dominant disease so there are no carriers. Someone who comes from a Huntington's family but does not have the disease cannot transmit it. Therefore, knowing who will get the disease is also knowing who will pass it on."

Would you want to know?

Like most illnesses, Huntington's leaves considerable room for uncertainty. Though it generally makes its appearance around the middle years of life, it may begin in childhood—or not until a person is close to 70. There would be little profit in knowing about it ahead of time, except in connection with childbearing. Many people might prefer this awful knowledge to the guilt they would feel in needlessly burdening their own children with the same disease.

It is in connection with children, in fact, that predictive medicine offers the most hope. For the first time in history we are acquiring the power to ward off some of the evil spells that seem to hover over the cribs of the newborn.

Our new power began in the 1960s with a test that made it possible to spot infants who suffered from

PKU (phenylketonuria), an inherited biochemical defect which can lead to severe mental retardation. Afflicted infants were fed a diet low in the amino acid phenylalanine, which prevented brain damage. In the past decade, scientists have learned to detect dozens of other defects in newborns in time to start effective therapy: give them a missing chemical or remove some factor in the environment that is particularly dangerous for them. In other cases they have learned to diagnose major defects even before birth, through amniocentesis (withdrawal of amniotic fluid from an expectant mother's uterus for biochemical testing).

It has also become possible to detect the *carriers* of various defective genes—healthy people who, if they married another carrier of the same gene, might become parents of a child who suffered from a serious disease. The sickle-cell trait, for example, is carried by more than 2 million Americans, mostly blacks, who are quite healthy in spite of one defective gene. If they intermarry, however, their children run a 25 percent risk of having sickle-cell anemia, a highly painful, life-threatening disease (see SMITHSONIAN, October 1973). Until a safe prenatal test for it is perfected, predictive medicine can offer only a warning to such parents: choose artificial insemination or adoption, or remain childless, for otherwise they are playing a game of Russian roulette with their own children.

Decisions, decisions, decisions—that is what predictive medicine implies. It will become increasingly clear that illnesses do not strike randomly, that we are born with specific traits which make some diseases more likely for us than others, and that there are specific measures we can take to forestall them. The only questions remaining will be how we decide to play the percentages and, after our decisions are made, the extent of our determination.

What makes it all so difficult is that we can never be sure our efforts will be worthwhile. There are few guidelines on how to weigh the conflicting risks that we face. The choices are complex. The young woman mentioned at the beginning of this article and her physician weighed both the enormous familial cancer toll and the danger of lifetime surveillance with its attendant possible cancer hazard from frequent diagnostic x rays, and decided on breast surgery before any trace of cancer appeared. Who is to say they were right? Doctors, too, must weigh the risk of inducing widespread cancerphobia, hypochondria or food faddism against the need to alert people to their individual genetic vulnerabilities.

We will need much help from statisticians and epidemiologists before we reach a firm base for our decisions. Without such guidance, an inveterate smoker who reads about the high rate of traffic accidents might well decide to throw all caution about cigarettes to the winds, even if he *is* particularly susceptible to lung cancer, in the belief that he is most likely to die in a car crash, anyway.

One thing is clear: the burden of responsibility for our health is shifting away from doctors and hospitals, and coming to rest on us. Are we ready to accept it? Recently Dr. Marvin A. Schneiderman, associate director for field studies and statistics of the National Cancer Institute, estimated that close to 100,000 lives a year could be saved if Americans stopped smoking, drank less and ate more roughage or less fat or both, but noted that "the most difficult thing is to get people to do things for themselves and do them every day."

It is unreasonable to expect widespread asceticism and reforms from everyone. Besides, we don't all need to take so many precautions. As the National Academy of Sciences' recent report on genetic screening points out, "The genetic view . . . suggests that non-susceptibles should be spared the fearful anticipation of events that never materialize and the onerous requirement to abide by rules that are, for them, irrelevant." The best hope for rational behavior—as well as effective prevention—lies in pointing out to specific people which particular conditions are most dangerous for them.

Predictive medicine is still in its infancy. It will be welcomed by many, resented by some, feared by others. But at least it recognizes that each of us has a unique combination of genetic weaknesses and strengths that can be explored and accommodated on an individual basis. If we take predictive medicine seriously, we may yet learn to escape some of the most unpleasant hazards of the human condition.

Able to look into her own future, a woman may find she would rather not have seen some of the images.

Bathed in the eerie light of Cerenkov radiation, produced by particles moving through the water faster than the speed of light in water, is the core of the Omega West research reactor at Los Alamos.

By Peter Gwynne

Plutonium: 'free' fuel or invitation to a catastrophe?

This waste, worth about $4,000 a pound, could be used as a reactor fuel, but we must decide if benefits are worth the risks

Plutonium. The stuff of bombs. Intensely radioactive for hundreds of thousands of years. For many Americans, the very word invokes a dread akin to botulism or anthrax or worse.

Plutonium is indeed deadly, and more is being produced every year. Men make it deliberately for weapons of war, and they make it inadvertently in nuclear power plants. Now the United States and other countries are deciding whether to use it to fuel nuclear reactors of the future.

Some critics contend that a decision to use plutonium as a fuel will inevitably lead to a disaster. Sooner or later, they say, human error will cause an accident during processing, shipping or in a power plant, and plutonium will be released to the atmosphere, causing widespread death and disease. Even worse, they say terrorists could seize a shipment, put together a crude atomic bomb and bring a government to its knees. Finally, they raise the problem of disposing of a substance that remains dangerous many times longer than the lifetime of any recorded civilization.

But supporters of the "plutonium economy" argue that this potent source of energy will eventually be urgently needed, when coal, for instance, presently plentiful, becomes too scarce, too polluting and too expensive. They say that the element is not as toxic as it has been made out to be, and that present techniques for handling and guarding "hot" substances are more than adequate to prevent catastrophe.

Plutonium is a very heavy metal with some Promethean characteristics. Although exceedingly minute quantities exist in nature, it is essentially a man-made element, discovered in 1940 at the University of California at Berkeley. Bombarding a uranium compound, they found first neptunium, which broke down in a few days, and then plutonium. Like some forms of uranium, plutonium underwent spontaneous fission; every so often one of its atoms would split apart, releasing a tremendous amount of energy in the process. Whether this energy is worth the risks is what the fight is all about.

In some ways plutonium is no different from other heavy metals, such as uranium, thorium and even lead. It can be melted into ingots, machined into rods, rolled into foil and stretched into wire; it can form alloys with other metals. Plutonium combines with carbon, nitrogen, oxygen and other elements to form stable compounds. The plutonium used in reactors is an oxide.

Like most other elements, plutonium exists in different forms called isotopes (each isotope of an element has the same number of protons and electrons, but a different number of neutrons; hydrogen, for example, exists naturally in three isotopes). A unique characteristic of some plutonium isotopes is that they are self-heating: a chunk of Pu 239 is noticeably warm to the touch; another isotope, Pu 238, is literally too hot to handle. (Pu is the chemical symbol for plutonium; the number of each isotope is the sum of its protons and neutrons.) They are hot as an indirect result of their radioactivity: their crystals absorb their own radiation.

All 15 isotopes of plutonium are extremely radioactive. Its radiation has little penetrating power, however: a piece of cardboard can be an effective shield, in contrast to the walls of concrete needed for other radioactive elements. But this low power presents its own deadly problems. If a speck of plutonium manages to get inside the body, its radiation is dissipated within a very short space, severely damaging the tissues surrounding it. A speck in the lungs can cause fibrosis within a few weeks.

Experiments on laboratory animals leave no doubt that plutonium is a potent carcinogen. Most commonly, airborne particles can cause lung cancer. Introduced through the mouth or an open wound, plutonium tends to migrate to the liver and skeleton, where it can produce cancer of those parts of the body. Experiments involving humans have been performed in this country as well. Between 1945 and 1947, federal officials wanted to know just how dangerous plutoni-

Peter Gwynne, a metallurgy graduate of Oxford and former editor of MIT's Technology Review, *is now the science editor of* Newsweek.

um really was, especially for the scientists and technicians working on the bomb at Los Alamos. So from two to 145 times what is now the current standard of plutonium that the human body can tolerate was injected into 18 patients from 4 to 65 years old (most of the patients were middle-aged), all of whom had been diagnosed as already having terminal illnesses. Most of the patients died within a few months—although as a result of their diagnosed illnesses, government scientists insisted, not the plutonium. Two patients, however, survive to this day; one of those patients still living had plutonium injected into a cancerous leg that was later amputated.

Officials at the Energy Research and Development Administration (ERDA), which now oversees research on nuclear matters, insist that no government would tolerate experiments of this type today, but they add that the information obtained was invaluable in setting standards for plutonium exposure. Others now say the study was completely unnecessary because the same information could have been obtained from the considerable number of people who had been exposed to plutonium on the job.

The government has also kept close watch over a group of 26 workers who were exposed to plutonium at Los Alamos. Since 1945 one of them has died of a heart attack, but none has developed any cancer. In 1968 the government began a registry of people who have been exposed to plutonium and other transuranium elements. Their medical records can be released to scientists studying plutonium's effects. And this year the government is beginning a long-term study that will involve a few thousand patients who have been exposed to plutonium, as well as control groups. In fact, government officials are quick to point out that so far they have no evidence that any human being has ever contracted cancer from internal exposure to plutonium. Nobody is saying that plutonium is not dangerous, but the medical records seem to show that its dangers to the body may not be quite as bad as is sometimes thought.

No one doubts, either, that plutonium can be harmful to human health when incorporated in a bomb. Nuclear war has been a specter for 30 years, but now some physicists are warning that terrorists, too, may turn to atom bombs. In 1974 atomic physicist Theodore B. Taylor and lawyer Mason Willrich published *Nuclear Theft: Risks and Safeguards* to spell out the danger. They argued that making a "crude fission bomb" required little more than a scientifically trained mind and about 12 pounds of plutonium oxide. Acquiring the plutonium would be relatively easy for one person acting alone, a criminal group or a dedicated terrorist group, they said, because security was lax at nuclear plants.

India's explosion of an atom bomb, produced with plutonium from reactor wastes, indicated that the path from swords into plowshares is not a one-way street. But the nuclear establishment argued that bombs still required well-trained teams of scientists.

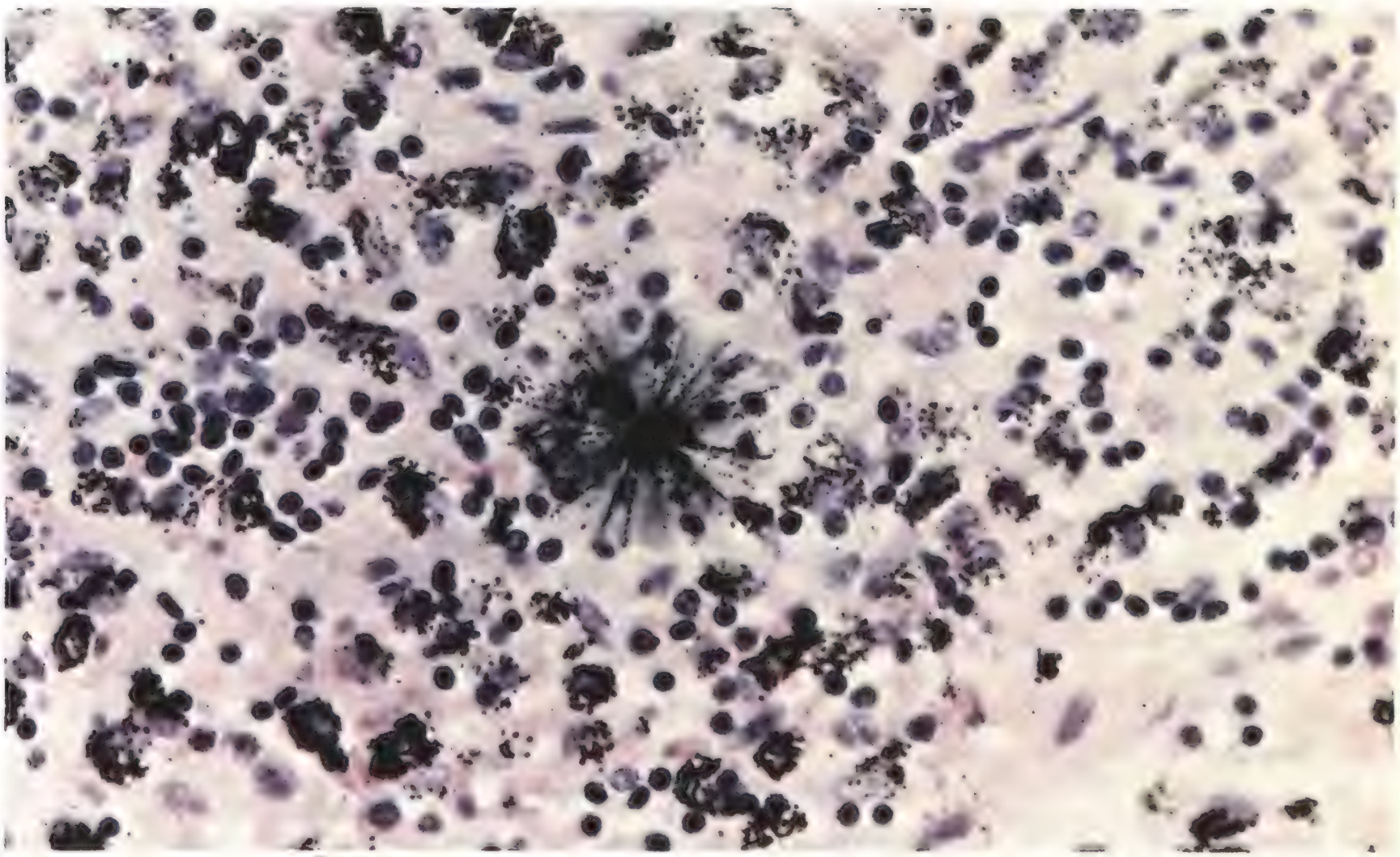
Then *Nova*, the public television science program, invited a chemistry major at the Massachusetts Institute of Technology with no experience in nuclear engineering to design a bomb, using only information he could find in the unclassified literature. He did it in a matter of weeks. Shown the design, an expert at the Swedish Ministry of Defense said: "There is a fair chance that it would not go off . . . [but] there is also a fair chance that it would." The student, who refused to be identified for fear of kidnapping, said he was surprised at how simple it was. He estimated that the primitive device would cost about $10,000 to build and would require about 15 pounds of plutonium—an amount produced in two weeks by a typical commercial reactor. Critics said that if the atomic bomb exploded, it would probably have the destructive force of 1,000 tons of TNT and could kill 100,000 people.

Right, now, extracting plutonium from reactor wastes is difficult and dangerous: the spent fuel is extremely radioactive, and the plutonium is much too polluted with uranium and reaction by-products to be easily converted into bomb-grade material. But if the Nuclear Regulatory Commission (NRC) decides in favor of plutonium as a reactor fuel, the situation will change radically.

The dream of "free" fuel

The great attraction is getting something for nothing. The fuel in conventional reactors is uranium 235 mixed with a much larger quantity of uranium 238. Plutonium is made when an atom of nonfissionable

An atom bomb explodes in 1955 Nevada photograph.
"Lightning" is trails of instrument-laden rockets.



Magnified 1,000 times, the starlike object is radiation
from a speck of plutonium in a human lymph node.

U 238 absorbs a stray neutron, starting a short chain of events that eventually produces an atom of plutonium. On the average, one atom of plutonium is formed for every two atoms of uranium that fission. Because some of the plutonium will fission before the fuel is removed, the net result is one atom of plutonium for every four atoms of uranium. All reactors "breed" some new fuel in this way.

Now that uranium is becoming scarce and expensive in the United States, we are faced with the prospect of becoming as dependent on foreign sources for uranium as we are for oil, or switching to another nuclear fuel. By adding "free" plutonium to uranium in a mixed-oxide fuel, this country could significantly stretch its uranium supplies. The problem is that the plutonium would have to do a lot of traveling before it ended up as fuel in a reactor core. Starting as a component of spent fuel, it would be shipped from the power plant to a recycling center. It would then be shipped to any of a dozen fuel fabrication plants, and from there to any of the 100 or more power plants expected to be in operation by 1980. (The danger would arise after recycling, when the separated plutonium would be in a form terrorists could use; by the 1990s there could be enough plutonium in transit every year to make 20,000 atom bombs.)

Breeder reactors will produce even more. Breeders are still a long way off (the demonstration plant at Clinch River, Tennessee, has run into technical problems and spectacular cost overruns), but they remain the core of this country's energy policy for the future. Fueled with large quantities of weapons-grade plutonium, they will "make" about 20 percent more than they use; thus five breeders will provide enough fuel for a sixth.

The nuclear industry insists that existing safeguards can keep all this plutonium from hijackers. The amount that can be shipped on passenger aircraft is limited, and no containers which weigh 500 pounds or less may be shipped in open trucks, railroad cars or ships. Trucks are marked so they can be identified from the air, and truck crews must maintain regular radio contact with shippers. For stored material, precautions take the form of large security staffs and physical barriers. Nuclear plant guards search visitors and employees and patrol the grounds.

Critics insist that none of this would stop a dedicated group of would-be terrorists. They point out that a Pennsylvania utility was fined $8,000 in March after a former employee evaded a guard, scaled an eight-foot fence and entered a security area. They concede that the shipping record is perfect so far, but argue that the opportunity for theft rises with the volume of shipments.

If the NRC decides to go along with plutonium as a fuel, it is expected to require stricter precautions. One of these may be to "spike" plutonium with other extremely radioactive materials before shipping. Another would be the creation of a special federal police force whose sole responsibility is guarding nuclear material. Taylor estimates that proper security would cost about one percent of the total cost of operating nuclear plants.

If the NRC rejects plutonium as a fuel, utilities will have to dispose of all the plutonium in their spent fuel. If it is approved, they still will have to cope with unusable plutonium ejected at various points in the recycling process. In many ways this "ultimate garbage crisis" is the most intractable of all the problems facing the nuclear industry.

At present, large quantities of nuclear wastes containing plutonium are stored in double-lined stainless steel and concrete containers buried at Hanford, Washington. The system is not perfect: a 1972 AEC report noted that at least 660 pounds of plutonium had been allowed to leach into the ground. And burial at Hanford is plainly a temporary solution because plutonium 239 remains radioactive for a quarter of a million years. Spent fuel is piling up at existing nuclear power plants because at the moment there are no operational recycling centers. The plant at West Valley, New York, is closed until at least 1983 for modifications. A plant built in Illinois by General Electric for $64 million does not work and has been shut down. A third, being built in Barnwell, South Carolina, awaits NRC licensing.

Ongoing search for waste disposal

So far the search for a permanent method of disposal has led the nuclear industry down a number of blind alleys (SMITHSONIAN, April 1974), and no definitive answer is in sight. The government has considered burial in stable geological formations (Kansas salt mines were an early candidate), launching into space (possibly into the sun, for in that thermonuclear hell a little plutonium would present no problems), and using modern alchemy to transmute the plutonium into something less dangerous (it's not easy). ERDA said last year that burying nuclear wastes in stable geological formations looks most promising.

By any criterion, plutonium is an unpleasant substance to have in circulation. While its actual toxicity may not equal its reputation, the threat that it poses as the raw material of bombs puts it in a class by

Plutonium pellets, greatly magnified, emit alpha particles to create "sunbursts" in slide emulsion.

itself. The nuclear industry believes that its safety procedures can reduce the risks to a sufficiently low level to allow exploitation of its benefits as a fuel. Opponents argue that the benefits do not justify the risks, some going so far as to say that no benefits could justify the risks.

Caught in the middle is the Nuclear Regulatory Commission. The NRC had announced last November that it would grant interim licenses for use of plutonium while continuing studies of the fuel's safety. But then in May a federal appeals court ruled that the NRC had violated the National Environmental Policy Act and had established ground rules that were "at best vague and at worst disingenuous." Unless overturned, the court ruling will delay the use of plutonium fuel for several years. Once the study is complete, the NRC will have to hold hearings.

By that time the facts about plutonium, as far as we know them, will be part of the public record. The scientific and technical people will have had their say. But whether the benefits outweigh the risks is not a scientific question; it is a question of policy. That's where the American public comes in.

Before we decide, we should know that there are other choices. Do we have to go with plutonium or inevitably suffer high prices and even embargoes on foreign uranium? Other options do exist, enough of them to provoke corporations into magazine advertisements urging the federal government to come up with an energy policy.

Beyond what by now might be called conventional nuclear power, beyond breeder reactors, beyond the exotic (and energy-demanding) schemes such as tar sands and coal gasification, are at least three alternatives that both government and industry are looking at with varying degrees of interest.

The first is solar energy in its many forms: direct heating and cooling; conversion to electricity; windmills; even the ocean thermal devices proposed by space companies. A backyard industry for years, with only minuscule federal funding, solar power is becoming respectable, if not yet the wave of the future. NASA is building windmills, blue-chip corporations are fabricating solar collectors, solar homes are springing up across the landscape. (This summer in Washington, tourists are visiting an elaborate solar energy display on the Mall.)

A second possibility, fusion power, is also being actively pursued as a long-range solution. It offers some of the same benefits as the sun itself: clean energy, few problems, and an almost inexhaustible source of fuel in seawater. So far, fusion power is familiar only in the form of so-called hydrogen bombs, but physicists are ever so slowly learning to contain fusion reactions so that their heat can be harnessed like any other source of energy. The most promising results to date involve the use of lasers to supply the unearthly heat needed to start a fusion reaction.

The obvious option, of course, is as prosaic as plutonium is exotic: coal, the black rock that used to heat our homes and drive our ships. This country presumably still has enough coal to last us hundreds of years. But, like plutonium, coal involves decisions that are not simple. We must consider the losses, as well as risks, while weighing the benefits.

Our federal government is quietly adopting a policy of exploiting Western coal that lies under public land, or land to which mineral rights were reserved. That coal is claimed to be cheaper than Eastern coal, and the utilities and energy companies are anxious to dig in. But a long list of questions remain to be answered —and not only what will happen to the landscape, the water supply and the flow of capital. Coal policy is also a question of where industry will locate, and thus where people will live. Even more fundamental questions are being raised by critics of our emerging coal policies. If both federal and local laws are bent and even ignored to facilitate exploitation of Western coal, what kind of society will we be left with when we have satisfied our energy needs?

Like the plutonium question, all our energy decisions are complex. Worse, they are all interrelated. The scientists can tell us how dangerous plutonium may be, the economists can tell us how much electricity generated from Western coal will cost, but only we can decide which is worth the cost and which is not.

Glowing like some alien sun from its own heat, this sphere of nearly pure plutonium just 1.465 inches in diameter is about 1,700 degrees F at the surface.

By Charles E. Little

Atlanta renewal gives power to the communities

In Cabbagetown and other neighborhoods of a gleaming capital, blacks and whites, rich and poor, demand—and get—identity

Vintage cars and flappers parade in annual neighborhood festival at Inman Park.

Neighborhood: the very word is pleasant. Its syllables flow with deliberation and warmth, connoting a realm of peace, stability and fellowship. Yet everyone knows, alas, that when neighborhoods get in the way of progress—highways, high rises and other benefits of urban renewal and growth—the greater good that such progress confers must win out.

It is, therefore, something of a curiosity when an urban neighborhood—Greenwich Village in Manhattan, say—rears up and resists a crosstown expressway, asserting residential rights over those of the planners of the megacity. Many residents of Greenwich Village are well-educated and well-heeled; their hands have always been close to the levers of municipal power, if not actually upon them. But what are the chances of a neighborhood's defying those determined improvers of cities if its average family income is less than $5,000 per year, if its median educational level is seventh grade, if three out of four of its ramshackle bungalows are owned not by the families that live in them but by an absentee landlord? Such a neighborhood would have disappeared long since in most places—to become a housing project, an industrial park, a freeway interchange. But not if its name were Cabbagetown. Not if it were in the city of Atlanta.

Cabbagetown is one mile away from the central business district of Atlanta and a million miles away from the Atlanta of the hotel ads and Chamber of Commerce boosterism. The golden dome of the Georgia state capitol can be seen from the high ground near Cabbagetown, as can the soaring towers of the booming commercial heart of the "New South." Architect John C. Portman jr.'s ebullient Peachtree Center is a source of civic pride; but, says state legislator Gerald Horton, who represents the city, "The real story of Atlanta is in the neighborhoods."

The real story of Cabbagetown is that this neighborhood of 2,500 poor whites living in a six-block-square area near a partly defunct cotton mill is going to survive. In the 1950s the neighborhood had been written off by city planners. They zoned it for factories and apartments to replace the quaint but rickety mill-town houses that huddled around the Fulton Cotton Mill. Family ownership of the mill had ceased, and with it the needed services to the community. The houses were offered to the residents, but few could afford even their low cost. The new mill owners began laying off some of the workers and the houses were bought up by outside investors for as little as one or two thousand dollars apiece. Soon the community became what sociologists would call anomic. Its social fabric was rotting just as its houses were rotting. Drugs and delinquency overtook the children as despair overtook their parents.

And yet enough of the fabric remained—deriving

in part from a shared heritage from the mountain hollows whence the first families came in the 1880s to work the looms—to make a heroic effort to arrest the trend. New community services, many of them indigenous, began surfacing in Cabbagetown. One of the indigenous service organizations created at this critical time is called, appropriately, "The Patch," and it opened in 1971 in response to the concerns voiced by community residents.

Foremost among Patch projects is a learning center for Cabbagetown children. "What we needed," says Esther Lefever, Patch's energetic director, "was a supplementary educational environment. When public school teachers knew a kid was from Cabbagetown, they would assume the worst." Thus was "The Patch" launched, and named by the children.

Another Patch program is called "The Dandelion Project," an effort to establish a nature education center on some vacant land in the community in cooperation with the Georgia Conservancy and the city government. Still another is the Carrol Street restoration project, a program involving residents working together to restore and improve the houses and stores on this street as a pilot project.

All of these activities might well be quixotic under ordinary circumstances. In a city like Atlanta, poor whites have even less clout at city hall than poor blacks, who can call on strong national organizations for help, if only to protest. Joyce Brookshire, another community leader of Cabbagetown, felt sure that urban renewal would "wipe out" the neighborhood, if a planned interstate highway didn't get there first. Even so, with a kind of residual Appalachian defiance, they were determined to hold their ground.

That sentiment, a direct reaction to the frenzied growth and change of the 1960s, was gathering strength throughout Atlanta.

The 1960s were, perhaps, the period of Atlanta's greatest triumph—a time when the city became more than a second-class, regional trading center and emerged as one of the major metropolitan areas of the United States. Today, the Atlanta urban region has a population of 1.7 million. The city itself, however, has remained at just a bit under half a million. If the Sixties were the best of times for the region, they were the worst of times for the city. Says Commissioner of Budget and Planning Leon Eplan: "We very nearly lost the city of Atlanta."

During the period 1955 to 1965, Eplan explains, at least 67,000 people—some 15 percent of the population—were displaced by highways and urban renewal alone. "It was a chain reaction," says Eplan. "A neighborhood was redeveloped and its residents moved to an adjoining neighborhood, and then *those* people moved to the next. Recipient neighborhoods sometimes doubled or tripled their population. Some houses in which one family had lived suddenly had 15 families." The result was an increase in racial tension as neighborhoods rapidly changed in racial composition, some of them seemingly overnight. The upshot? "Atlanta ended up with worse housing after urban renewal than before. All social organization was destroyed. The population was disorganized."

Some estimates have it that throughout the region 50 percent of Atlantans changed their address during this period. Building the "Capital of the New South" was costly in ways that dollars can never measure. It is to Atlanta's credit that riots never erupted in the city as they did elsewhere. Instead, even as racial tension was exacerbated, there emerged a kind of common cause between the races: save the neighborhoods.

Atlanta's official seal carries the picture of a phoenix and the motto, *RESURGENS*. Local wits began describing General Sherman, who had destroyed the city 100 years before on his march to the sea, as Atlanta's "first urban renewal demolition expert." Atlantans be-

Mr. Little writes frequently on conservation and the quality of life. His article on community gardens was in SMITHSONIAN, *August 1974.*

Photographs by William A. Allard

The Patch serves as educational and social center for the neighborhood called Cabbagetown.

lieved that the second urban demolition could be surmounted as well, and in 1971 set up a commission to undertake a revision of the city charter—the first revision since Sherman's time—to help bring a new neighborhood "resurgence" about.

What the charter commission heard, and heard plainly, was a plea for neighborhood stability. The way to get it, citizens believed, was through planning and zoning. Many reforms were called for in the charter revision, but when it came to the governmental processes envisaged, Atlantans were frustrated most by their inability to affect the future of their own neighborhoods. According to Emmet J. Bondurant, chairman of the charter commission, "The citizens who appeared before the commission expressed 'least confidence' in city planning and zoning."

The result of this lack of confidence was that the new charter was written in such a way as to return substantial powers to the neighborhoods in planning for the future. One section calls for comprehensive plans to be prepared every year, in one-, five-, and 15-year versions, with the fullest measure possible of citizen participation in the process. Thus the neighborhood citizens of Atlanta not only helped to reform a charter, but they were also given the opportunity to shape the fine-grain specifics of their relationship to the planning process. The charter revisions were passed in 1973. The next step was to determine the details of a "Citizen Participation Ordinance," called for by the charter.

There is nothing new about "citizen participation," of course, and a charter revision is unremarkable. Urban demolition experts have a way, then as now, of being unimpressed by governmental reorganization, or even by citizens. This is particularly true of highway builders, as every American knows except those who have managed to remove themselves utterly, far from the madding crowd of Interstate planners. In Atlanta the bête noire among highways was Interstate 485. By the time this highway had come along, Atlantans had simply had it with the highway builders, who were not only lusting for I-485 but were also planning something called the Stone Mountain Tollway, which would deliver the besieged residents of neighborhoods to a countryside state park a half-hour's drive away.

These highway plans, like many others in the last stages of the interstate highway program, had the misfortune of attracting some powerful enemies. The proposed alignments would decimate an area known as the BOND community. BOND consists of five neighborhoods, which got together to fight highways specifically and to improve their neighborhoods generally. The coalition (the acronym stands for the Bass Organization for Neighborhood Development), includes Inman Park, an oft-cited example in the literature of preservation and restoration. In 1971, Inman Park was a neighborhood of decaying Victorian mansions that city planners had zoned for high-rise apartments and light and heavy industry. But the mansions had charm. As in other old, inner-city neighborhoods around the United States, the young and imaginative, rebelling against the predictable life-styles of their parents (birth-suburbia-death), bought the old houses to restore them to their former elegance. By 1973, the Victoriana of Inman Park was spruced up enough for the Annual Inman Park Festival and Tour of Homes to raise a war chest for fighting off the highway plans.

With Inman Park taking the point position, the BOND coalition, together with other affected neighborhoods, managed to get I-485 and the toll road "de-

Community Development Organization at
The Patch is there for the concerns of residents.

mapped." What is more, Inman Park, by hiring a professional planner to help make its case, also managed to induce the city council to strike out the apartment-industry zoning.

The great success of the Inman Park neighborhood and the BOND coalition was in transcending protest. Protest is, of course, endemic to city neighborhoods threatened by urban growth, but creative, responsible and effective neighborhood *planning* is not. This attracted the notice of a young, black, with-it city planner named Sandra Robinson. She thought the BOND experience might be a useful model for developing the "citizen participation" ordinance that the new charter mandated. "I decided I was going to let people know how to use that charter to get power." What better precedent was there than BOND?

Robinson, with the help of Shirley Harris, a "citizen involvement" colleague, and a group at Georgia State University which had been monitoring neighborhood activities, took a random sampling of Atlanta's 200-plus neighborhoods to see if a BOND-type approach were possible. "We met with neighborhood groups day and night," Robinson recalls, in an effort to see how an ordinance could be written that would create BONDs all over the city. A mayoral candidate, along with a number of city council candidates, began to realize the real import of the charter change. The charter called for the one-, five-, and 15-year plans to be based on "hearings held in each Council District in such manner as the council shall prescribe by law." By itself the phrasing seems innocuous. The "law" to be prescribed was the key that could open the door to neighborhood planning. The mayoral candidate, Maynard Jackson, and some council candidates went right on through. Says Sandra Robinson: "Every council person who ran on the neighborhood planning platform won." And so did Maynard Jackson, Atlanta's first black mayor.

The "Neighborhood Planning Ordinance," passed in 1974, describes just what a neighborhood is ("a geographic area either with distinguishing characteristics or in which the residents have a sense of identity and a commonality of perceived interest, or both"). It prescribes how all the neighborhood plans are to be pieced together into a comprehensive map and document for the city as a whole. The comprehensive plan is then re-presented to Atlanta citizens during "Mayor's planning week," so that the neighbors can see what they have wrought.

By the end of 1974, some 35 of Atlanta's neighborhoods were participating. One of the plans came from Cabbagetown, which had joined with adjacent Reynoldstown to produce a plan for two neighborhoods that were coming to see that they were one community with "a commonality of perceived interest."

What is of particular interest in the Cabbagetown-Reynoldstown alliance is that while the former is a white working-class neighborhood, the latter is a *black* working-class neighborhood and somewhat better off in the bargain. Says Cheryl Pence, a planner who joined Sandra Robinson and Shirley Harris in getting the program off the ground, "Five years ago when you asked the people in Cabbagetown 'Which way to Reynoldstown?' they wouldn't tell you." Adds Shirley Harris, "In those days when a black moved to a Cabbagetown street, the boundaries of Cabbagetown would automatically shift."

Renewal in action: Cabbagetown house gets
freshly painted amid the rubble of urban decay.

Leon Eplan, the commissioner of Budget and Planning, says the city almost went down the drain.

No longer. The old boundaries have given way to new ones which describe a coherent community. In July 1974 a survey of Cabbagetown and Reynoldstown residents asked the question: "What do you like best about your community?" Topping the list of answers: "My neighbors."

The neighbors had a good deal to say in their "Joint Neighborhood Plan." Among their recommendations, which have a tendency to be sensible, simple and explicit: pave the streets but don't widen them, change the zoning to residential, put in some parks, don't tear down any houses for tollways or subway parking lots, establish a public library branch. The joint neighborhood planning has paid off. The zoning is in the process of being changed, the community is getting a large (11-acre) park as well as a couple of small ones—miniparks wrested from MARTA (Metropolitan Atlanta Rapid Transit Authority) officials. Significantly, the whole community is gaining a sense of its own stability, not through the activities of government but through its own resources and will.

Says Thomas Hughley, a Reynoldstown community leader, "Before, we didn't know what to do. We'd just go ask the big man, who owned a store or something. Now, with Cabbagetown, we have a strong unit."

With or without help from city planners, other plans poured into city offices. Above all they wanted *stability* —not only for the children of suburbia charmed by the Victorian decrepitude of the Inman Parks, but for poor people, too. "We do want to stress," the Cabbagetown-Reynoldstown citizen planners wrote, that "Atlanta should be a city for all the people."

Down at city hall, the Bureau of Planning was making an effort to get "the mechanism," as Sandra Robinson calls it, ticking along. And it wasn't easy. Traditionalist planners were fearful that neighborhood "stability" might exact too high a price in the process of designing and building the basic delivery systems needed by a rapidly growing urban region—transportation systems, sewage systems, water systems, power systems, housing systems, solid waste systems, police and fire systems—all the systems essential for *economic* stability in a city whose highest priority had been to create a "better climate for business."

These concerns remain, and are important. But their recognition did not deter Leon Eplan, commissioner of the new Department of Budget and Planning which was created by Maynard Jackson under a charter reform permitting consolidation of departments (formerly there were 26, now there are nine). Working with Planning Bureau Director Collier Gladin and others, Eplan eked out the funds from various sources to establish a Division of Neighborhood Planning within the bureau. By the end of 1975, a reorganization of the bureau was approved and 11 full-time and two part-time planners were assigned, along with five planning interns, to help the neighborhoods prepare their plans.

These planners, together with their director, William F. Kennedy, are uniformly enthusiastic, committed and young. Most of them are still in their twenties. The neighborhood planning staff is divided into four groups, each covering large geographical areas of the city. To implement the purposes of the program, the city comprises 24 different "neighborhood planning units" (NPUs).

George Varki, for example, heads a group responsible for a cluster of NPUs ranging from well-off to hopelessly depressed, and including the central busi-

Sandra Robinson, one of many young city planners, worked to get a law to safeguard neighborhoods.

Architect George Varki understands urban poverty and the need to keep the stricken districts alive.

ness district of the city. Varki, born and trained in India, could be expected to know something of urban despair and be hardened to it. He is not. In one neighborhood Varki is concerned about a city-wide program of "code enforcement." Minimum standards of plumbing, structural safety, wiring and the like are necessary, but, Varki asks, "How do you get people earning less than $3,000 a year to undertake extensive repairs without driving them out of their home?" When that happens, as it has in Varki's area, slumlord-owned housing can become "worse than slums."

Varki and his colleagues are also concerned about their credibility. They learned that it may come more quickly from small accomplishments than from elaborate plans. Varki is trying to work out some kind of accommodation with the Atlanta Housing Authority on code enforcement to help keep this neighborhood alive and improving.

Cheryl Pence is the only holdover from pre-reorganization days, and as such the old hand in the division. Besides working with Cabbagetown, Reynoldstown and the BOND community, she is hoping something can be done in the neighborhood that contains the Ebenezer Baptist Church and the birthplace of Martin Luther King jr. One of her most compelling issues is the fate of a large, T-shaped tract a mile or so wide and several miles long, a cleared area that was proposed to be the intersection of I-485, the East Atlantic Tollway and the Stone Mountain Tollway. If the city can hang onto the land, it will become Atlanta's "Great Park." A recent city council resolution guarantees that the planning for the area will not take place in a designer's ivory tower, but in the neighborhoods it will most affect. Cheryl Pence will be working with them.

If these activities sound unlike the cool, bureaucratic proceedings that charactertize most city-planning operations, that is as it should be. Says Ginger Slaughter, also a neighborhood planning group leader, "We call it the 'bubbling up' process, rather than the 'trickling down' process of planning."

Occasionally, it gets a bit *too* bubbly for Division Director William Kennedy. "We have to pinch ourselves to keep from being idealistic," he says. "You do get caught up in it." As a result, Kennedy, contrary to all accepted managerial technique, has, at one meeting at least, felt constrained to give something of an anti-pep talk to his staff, pointing out that they are still representatives of city government, not civic leaders, that they are professional planners, not activists. But these views do not keep planner Calvin Ashburg from blurting out, with no little incredulity in his voice: "We may actually influence the system!"

Echoes Sandra Robinson, who helped start it all, "The city may pay my salary, but my heart is in the neighborhoods."

The young neighborhood planners have no corner on enthusiasm, however. In fact, Leon Eplan, the fifty-ish commissioner who is the city's chief planner and fiscal policy officer rolled into one, manages to bubble with the best of them. Eplan, a third-generation Atlantan, is a planner with an enviable national reputation. He was recently elected president of the prestigious American Institute of Planners.

Eplan has in mind a series of village neighborhoods,

each with its own leadership, functioning individualistically but interdependently as a component of the whole city. He would make urban villages not only more complete in and of themselves—with their own shopping streets, community services, and some economic functions—but quite different one from another. One way to start this process of neighborhood identity is simply to have different kinds of street signs and gateless gateposts at major entryways to neighborhoods. Such boundaries, Eplan believes, "aid the task of familiarizing people with their community."

Can such visions achieve substance? Leon Eplan believes they can. The crucial factor, a factor that Eplan thinks may be unique to Atlanta, is the charter-inspired linkage between planning and budgeting. With this linkage, Eplan insists, the city's comprehensive plan—built as it is on the wants and needs expressed by the neighborhoods—is not just a plan, but "the chief *budget* policy statement." Thus can planning priorities become budget priorities. Neighborhood planning, which can direct much of the priority-setting, then becomes, as Eplan put it, "the central process of government."

It must be said at this point that Atlanta is still a deeply troubled city. The recent economic downturn has cut deeply into the city's growth. Local taxes are climbing alarmingly. Corporations are still fleeing to the suburbs, as are some white families unable to cope with a transition that, in the words of Jane Yarn, a socially prominent civic leader, was "three generations of change packed into 15 years." There are signs that "white flight" may be slowing down. But joblessness is high, and with it, crime, perhaps the most compelling of the city's current preoccupations.

It is, therefore, all the more impressive that Atlanta, in the very teeth of adversity, can transfer a significant amount of power—at least potentially—to its ordinary citizens in order to achieve a dream not of soaring towers, but of neighborhood.

If Atlanta is among the first to institutionalize neighborhood power, its citizens share with residents of almost every large city in the United States membership in a nascent popular movement which some call neighborhood (or community) decentralism. Decentralism may very well be the growing edge in citizen politics these days. Says Milton Kotler, a political scientist based at the Institute for Policy Studies in Washington, "This is the next, great citizen movement." In fact, it may be even greater than its predecessors—civil rights, environment, consumerism—because it combines elements of all of them. Municipal governments in more cities than Atlanta have recognized this and have provided means for its expression, although not in such a freewheeling way as Atlanta. Pittsburgh, Portland, Fort Worth, New York City and Washington all have programs for neighborhood "input" to governmental decision-making. So do scores of other cities.

Even the Congress is beginning to take note. Senator Charles Mathias of Maryland told a national town meeting that neighborhoods could achieve new powers of self-determination based on Thomas Jefferson's Proposal for Little Republics, which, Mathias believes, "can be practicably adapted." Senator Mark Hatfield of Oregon, for example, introduced a "Neighborhood Government Act" last year. It would allow individuals "to contribute a percentage of their Federal Income Tax directly into neighborhood government associations for the purpose of providing their own community services and enhancing political participation by members of these communities." The percentage Hatfield proposes (between 20 percent and 80 percent, depending on income) would, observes one of the senator's aides, "amount to billions and billions of dollars."

At issue, however, is not money so much as power. In Atlanta a concatenation of events made it both necessary and possible for a new kind of neighborhood hegemony to take hold.

Even if Atlanta succeeds, it does not necessarily follow that other cities will. Nevertheless, idealism keeps bubbling up in America. Jefferson is evoked both in the halls of Congress and in the neighborhoods. Down in the Grant Park-East Atlanta area, Alan J. Keck writes to his fellow Neighborhood Planning Unit members: "According to Thomas Jefferson, 'the way to have a good and safe government is . . . to divide it among the many, distributing to everyone exactly the function he is competent to do.' "

Inner-city Atlantans cherish splurges of Victorian fantasy, as displayed in this Inman Park house.

By David E. Lilienthal

New opportunities for 'underdeveloped' America to seize

'There is neither lack of work to be done, nor of resources to do it with.' And our top resource is the individual citizen

Something very healthy is happening in America today; it will profoundly influence our country's future. The centers of human vitality, imagination and authority, formerly few and centralized, are becoming many and dispersed. I see the future of this young and still underdeveloped land becoming one of diversity, not uniformity, decentralized, not centralized. We are seeing the individual citizen resume a positive and ever more consequential influence on his own life.

There are many who will disagree; they on the contrary believe we are in the very twilight of individualism, the individual growing smaller while our institutions and machines wax larger. They feel that the enormity of our institutions, the complexity of our economic society, the awesome impact of technology and machines all diminish the size of the individual, so he cannot even comprehend what is going on around him.

If that were true, our prospects would be bleak. But it is not a true picture of the trend; it is not what America is about. It is the very complexity and increasing interdependence of our society that is causing the individual to take charge more fully, and to manage his own affairs. More and more, he is doing so.

To win the favor and assent of the individual citizen is the central objective of all seekers of political power. They woo him more ardently than ever, exert themselves to persuade him, to manipulate and bamboozle him. (That is becoming more difficult; consider the declining power of the party machine, and the growing numbers of voters who register as independents.)

There is a monumental irony in all of this. While the politician and government officeholder must attach more importance to the individual, the individual attaches less importance to politics, is less interested in the apparatus of government. As everyone knows, apathy about voting is rampant; despite the hullabaloo about elections in the press and media, qualified voters stay home in droves. The abstention is significant as one symptom of a new epoch in the private citizen's role in our society.

Despite the unselfish and inspired efforts of such men as John Gardner of Common Cause, Americans seem more and more to sense that it is not in politics or in government that their energies and ideas can best be brought to bear upon their own futures, the welfare of their families, the interests of their own communities. A significant example: the citizen's allegiances to non-governmental organizations cover most of the areas of human interest, from conservation to health service, education, art; they are increasing in number and influence. These are signs of what is to come.

Through nongovernmental organizations, the citizen has acquired a power of veto of a magnitude unexampled in history. Simply by voting not to work, a handful of individuals can immobilize a whole community, or endanger the health and safety of millions. The larger an enterprise may be—a city, or a great national corporation—the more vulnerable it becomes to the sentiments and actions of private people acting for themselves.

This is notably true in the so-called private sector. Nowadays an individual with only a few shares of stock can and often does cause a great corporation to explain and justify its policies and practices, even on social issues, to all its stockholders and to the public as well. How hard corporate management works to get the proxies needed to defend itself against the

Mr. Lilienthal, a founding director of TVA and first chairman of AEC, heads Development and Resources Corporation, a private company.

private citizen's interventions as a mere shareholder!

The vast aggregations of capital in banks and in industry, though alarming to some people, are in fact held by quite vulnerable institutions, touchy to criticism and expressions of doubt. Their officers are nervous men, for we have seen their thrones—and huge salaries—topple in the wind of adverse public opinion set in motion by private individuals. The expensive, sophisticated advertising campaigns that our large businesses go in for these days are not intended merely to sell their products and services. They are more often intended to explain and promote their economic doctrines, the correctness of their social attitudes at home and even overseas, and, above all, how highly they regard and respect their real rulers, the mass of private individuals to whom they know they are answerable.

On a more affirmative side, look at the environmental protection movement, now so powerful and on the whole rightly so. This movement was the creation of private citizens, not of public officials. And this is but one of many kinds of affirmative, creative, *individual* power that have significance in the shaping of the future of America. There are many other manifestations of the same spirit of private initiative at work, all over the country; for instance, the proliferation in recent years of art and music throughout the nation, in scores of privately sponsored galleries, museums and other institutions—and not by any means only in New York. Who would have thought 40 years or more ago, when I had just started my career in the Tennessee Valley, that the day would come when so provincial a city as Knoxville was then would have its own professional symphony orchestra or its own art gallery?

I have described America as underdeveloped. I mean that description literally, in this sense: that no matter how far we may already have come, and that is a long way, there is no doubt that we have a whole lot further to go. In terms of our needs and our potentials for progress as well, this may, indeed, be the most underdeveloped country of them all.

The list of what we need to do will always be a long one. Some examples of present urgencies:

The nutrients and fertility of our soil, which we use up in vast quantities, and also export in the shape of massive sales of grain, have to be protected and renewed. New styles of agriculture, lending themselves both to the family commercial farm and to cooperative agribusiness, have to be devised and encouraged. It will require, among other things, changes in the laws that provide tax havens and, therefore, artificially promote huge impersonal corporate farming.

Our national railroad freight system, once the key to the very life of many cities, small towns and regions, ought to be modernized and expanded. Surely this would be preferable to the runaway growth of an already overextended highway system.

There is a need for new communities in which people can live in dignity without the waste and discomfort of hours of commuting to large cities. Need, too, for new community institutions to manage them and keep them healthy. (See, for example, the story of Atlanta, beginning on p. 100.)

In both the intermediate term and the long pull, our most vulnerable deficiency, and therefore our most urgent need, is for additional sources of energy, safe ones, bearing a minimum risk of pollution. One source of energy still almost untapped is in our vast coal resources, and their potential for a synthetic oil and

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The author, right, takes Senator George Norris on 1935 TVA inspection tour.

gas industry. We need also a far better designed atomic energy industry, and a start on a genuine all-out solar energy program. And we have somehow neglected developing to the full the wasted energy of the water in our rivers and canals. Barely one-third of the hydroelectricity that can be derived from our waters—especially our small streams so far overlooked by advocates of big dams—has thus far been put to work.

Finally, the greatest development need of all: the development of the talents and skills of our fellow Americans—providing training in higher skills for millions whose careers are stalled, their potentials inadequately used, to fit them to perform the satisfying, rewarding work that the development of America will require.

What stands in the way of doing all this? Certainly not physical limitations. There is neither lack of work to be done, nor of resources to do it with. Plenty of land, plenty of coal, plenty of water, plenty of ambitious and eager hands. What is presently lacking, but will surely come, is a resurgence of the high hopes, the sanguine spirit, the heart and drive that carried people from the Atlantic seaboard over the mountains, across great rivers and plains, the inspired enterprise of hundreds of thousands of private individuals that gave birth to a great country.

We need to take a fresh, radical look at our country. Old remedies and devices will not do in these new times. It simply is not the same country that it was 100,

50, even 25 years ago. The old slogans—Square Deal, New Deal, Great Society—no longer fit; they are irrelevant to our present imperatives.

Irrelevant because they were the concoctions of a centralized culture, proclaimed in the few centers of power—and of public relations wizardry and image-building—that existed in their day. But now our sources of human energy, imagination, capital resources and organizational talents are no longer the monopoly of a few great cities, nor are they confined to the elite of wealth or intellect or family who for so long called the tune for the rest of the country.

I do not subscribe to the view that what we most need, in this diverse and decentralized country, is *national* planning. Now, of course, the United States *has* practiced national planning, in one sense or another, almost from its very beginnings. The opening up of free lands in the West was national planning, and so was the establishment of land-grant colleges in Lincoln's time. That kind of planning required no feasibility studies or complex, cost-benefit ratio exercises. It was simple and effective planning, really just decisions to take certain action, which, in the judgment of good and wise men, would turn to the nation's advantage. The great developments that proceeded from those decisions might never have happened had the procedure been any less simple and straightforward.

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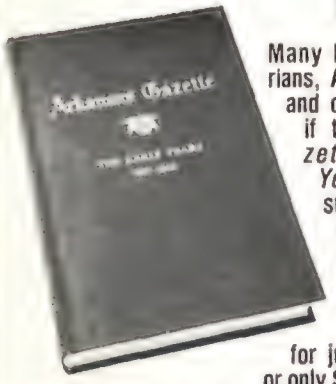

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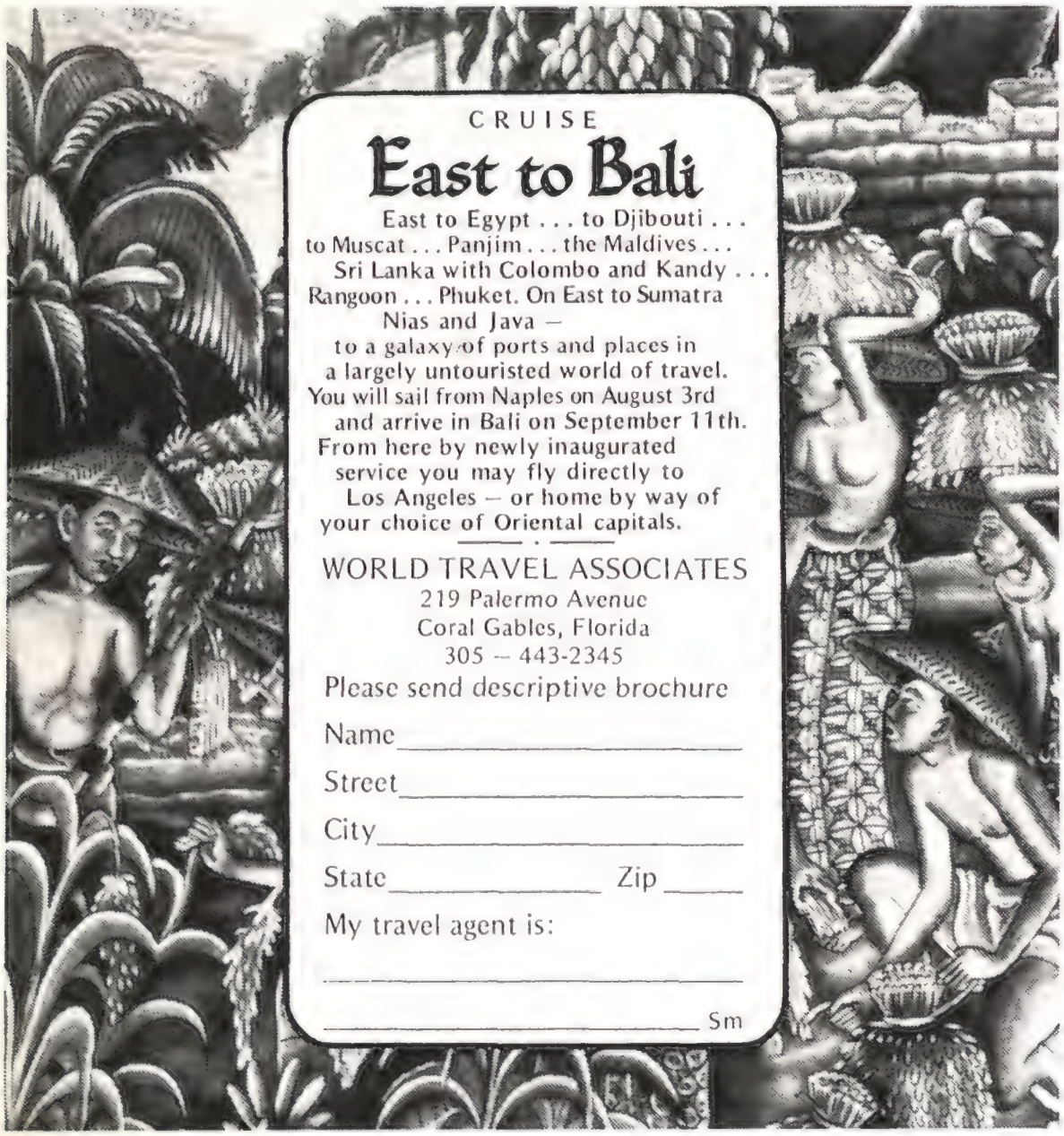
Atomic Energy Commissioners meet at Oak Ridge, Tennessee, in 1945. From



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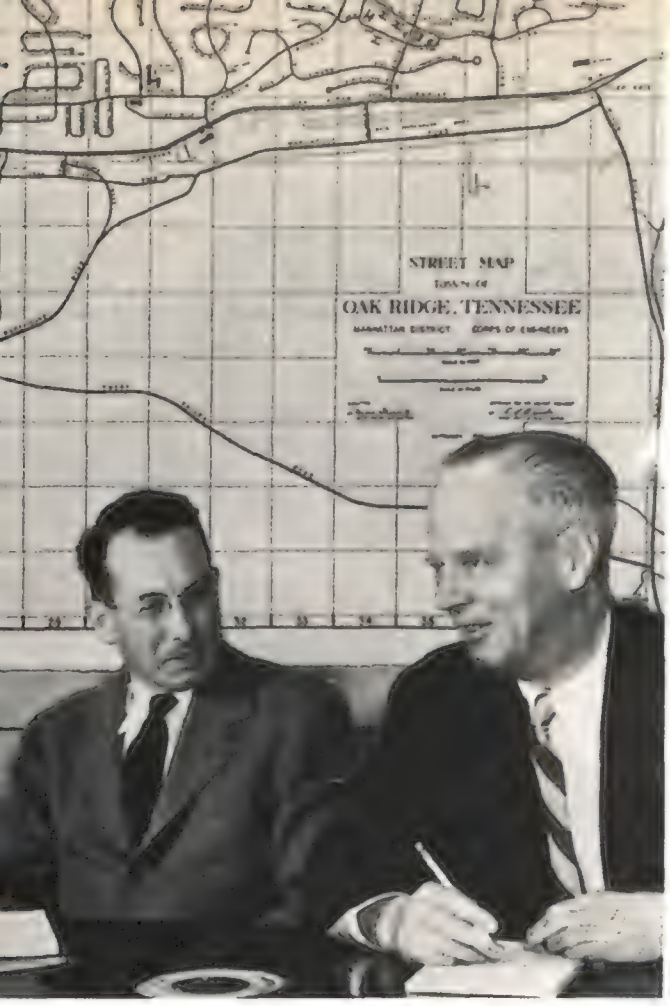
an entirely different version of planning. If it means statistics, numbers and monetary gimmicks, then it will be utterly ineffective. I don't sense the *action* in it. The notion of a national plan for so diverse a country as this is a prescription for unreality. Planning that is real, that leads directly into action, will take place in communities all over the country, in cities, towns, counties and even regions. Such planning ought to be professionally guided, but it must be responsive to the needs of the private citizens of the community, who know those needs best.

It is a tenet of my faith and experience that unless planning and the carrying out of plans are recognized as parts of one and the same function, nothing much happens. Planning is useful; the capacity to follow through and make something of the plans is all-important. Our present sickness is a lack of resolution to *act*. That is what is responsible for the present-day fashion of downgrading our prospects and denigrating our capacities, for an apologetic frame of mind about ourselves, for our timidity and lack of confidence.

What we need most is the courage and resolution to *act* on our plans, to modify them and keep them current, but never to lose sight of their objectives. Let me give an example of what happens when the objectives are forgotten and the determination to act is missing.



left: Lewis L. Strauss, Lilienthal, Robert F. Bacher and Sumner T. Pike.

In 1945 this country had an atomic monopoly. It presented to the world a plan later called the Acheson-Lilienthal Report, designed to avoid the dangers of an atomic arms race and prevent the spread of nuclear weapons by the internationalization of all nuclear technology and development, with responsibility for control of all dangerous materials and techniques vested in an international authority. No one, including the Soviet Union, did or could question the objectives—to free the world of the most menacing cloud ever to hang over mankind.

But when the Soviet Union did reject that particular plan, not because of its objectives, we turned aside in time to an alternative and different plan, bearing the bitterly ironic name of "Atoms for Peace." The results have been diametrically opposed to the objectives of the original plan. The nuclear competition between nations became more furious and insane; today the prospect of an atomic war has drawn measurably closer.

In the past few months we have been presented with this spectacle: French and West German manufacturing interests have agreed to provide the Pakistanis and Brazilians, respectively, with equipment that could enable them to make nuclear weapons. The Pakistanis, meanwhile, remind the world that their neighbor, India, already has that capability,

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Eleanor Roosevelt presents a 1949 Freedom Award to Lilienthal.

and the source of India's device was a nuclear reactor bought from Canada years ago, for ostensibly peaceful purposes.

How tragically short this result falls of the high intentions of those who promoted Atoms for Peace!

The damage in this case is not yet irreparable. As I see it, the greater hazard we face is that the sense of resignation to the inevitable, the feeling that we have no choice but to continue on our present perilous course, should become pervasive. Such sentiments are unhappily apparent, both in the seats of American authority and among the American intellectual elite, but they must not be allowed to infect the rest of us. If they should do so, then we are certainly headed for disaster. I have recently suggested that we act—alone if necessary—to resume the leadership role that we so long exercised, and simply and immediately ban the export of any nuclear technology, equipment or know-how to any nation in the world.

The argument against this is that some other nation will step in and take over our role as the world's greatest nuclear proliferator. Perhaps. But it is also possible that such an American step would energize the endless and so far largely fruitless international negotiations on the subject. In any event the stakes are too high, the urgency too great, for complacency or weak-kneed resignation. We, the people of the world, do have a choice.

There is so much to be done in developing this underdeveloped country that we ought to be getting on with it. Anyone with a concern for our future will think

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first in terms of jobs. In a country which has such need to put its physical and human resources to productive work, major unemployment of the dimensions we are presently experiencing is a disgrace. Academic economists have become too immersed in statistics: unemployment, wherever it occurs, is not a concept or an abstraction, an economic indicator, a theoretical counter to inflation, a tolerable percentage figure of seven or eight or ten percent or whatever it may be. Unemployment is millions of human beings who seek the happiness and self-respect of work and can't find it. Unemployment is the hundreds of things America ought to be getting done and isn't doing.

Those simple facts may not be readily comprehended in the remote seats of centralized authority, or by the theoreticians of the "limits to growth" school. They will be obvious enough in the communities, large and small, across this land. To be content as a nation with what we've got, to treat low expectations as virtues, flies in the face of the individual's needs and ambitions for himself. It is not in the nature of private men and women to discount their future as the zero growth advocates do. Our strength of purpose in our communities is what it will take to get this young and still underdeveloped country on the way again. I believe it is beginning to happen.

Lilienthal, a corporation executive now, spent 20 years in public service.

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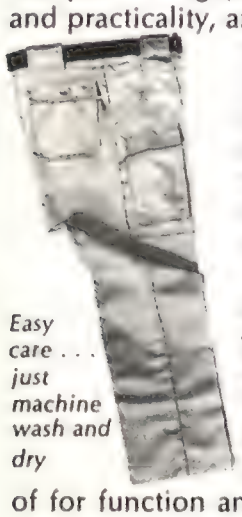

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Books: some suggestions

For this special issue concerning the future, the editors of SMITHSONIAN asked people from various fields and walks of life if they would single out a book in their own realm of interest which they felt one should read in order to be better equipped to understand the events of the next few decades.

A number of them declined the invitation on the grounds that no one book in their field could be considered *the* book. Some others, feeling less inhibited by the form of the editorial request, chose more than one. (Note: all of last spring's major Presidential candidates were invited on the off chance that these extraordinarily busy people might find the time to take on the task. One did.)

ROBERT COLES
Research Psychiatrist
Harvard University

No book, for me, tells us more about this country and the various social and cultural, not to mention philosophical and religious, predicaments it is likely to face in the coming years, than Walker Percy's *Love in the Ruins*—a major statement and analysis by an important and unique American novelist about this secular nation of ours, so taken up with various forms of idolatry, not the least of which, Percy knows, are the social sciences, whose often bloated language has become part of our everyday life, and whose "applied" knowledge plagues us: the messianic cultism of encounter groups, sensitivity training, and lately something called est, all part of the malignant self-centeredness, that will, one fears (and Percy predicts) not only grow by leaps and bounds during the final years of this century, but threaten whatever religious faith, personal dignity and thoughtfulness with respect to others we may have as an inheritance.

EDWIN NEWMAN
NBC network correspondent

I recommend *The Twilight of the Presidency,* by George Reedy.

It explains concisely how we got into the mess we did over the Presidency, and it was—considering that it was written before Watergate—remarkably prophetic. It says a great deal about the swollen Presidency, swollen press relations, swollen Washington, political egomania, sycophancy and much more.

These problems persist, and the book therefore retains its value.

It is a model in another way—it is short and to the point.

JOHN D. MACDONALD
Author

As the book which best enables one to comprehend the changes we may expect in the next 25 years, I would select the one-volume condensation of *A Study of History* by Arnold Toynbee.

His special insight was to ascribe to all organized human institutions, from governments to religions to corporations, a life cycle similar to the biological life cycle of a living organism. There is infancy when the institution is most vulnerable, youth when its members are most devoted and idealistic, maturity when it is at the apex of wisdom and strength, old age when it is once again frail and vulnerable, and finally comes the time of decay and death.

Toynbee teaches us that this cycle is immutable, that recognition of its existence and effects can be used to alter its duration but slightly. He tells us that the cycle exists outside the domain of moral considerations, and that all the organizations man puts together, whether out of good or bad motivations, follow the inevitable pattern.

Understanding the future means, then, determining just where on the cycle one can find those institutions which most

What will it take to make jobs for your children?

We need to get unemployed people back onto business payrolls—and the sooner the better. Right now, America needs millions of jobs.

But there's also the challenge of a *growing* work force—young people reaching working age, and others entering the job market. *Your* children and ours. That work force will grow by at least 1½ million *every year* from now through 1980.

What will it take to create *new* jobs for them?

Money. The huge sums of money (investment capital) companies need to upgrade and expand their facilities. It's *those* facilities that, when business picks up, maintain jobs and create new ones.

How much money's needed? The average investment to create a *single* new job opportunity in manufacturing is around $25,000 today. It will be at least $35,000 in 1980.

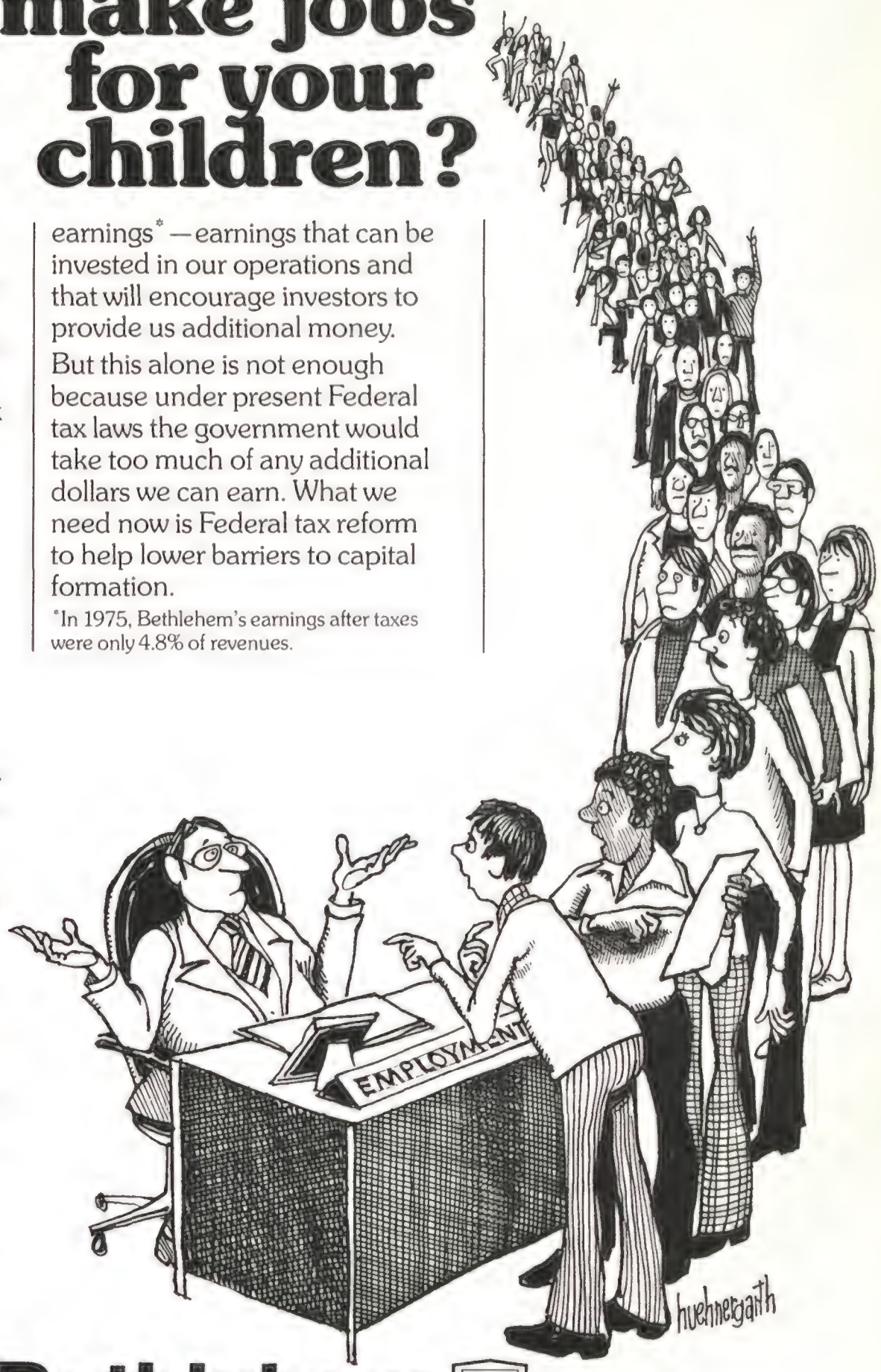
That multiplies out to $37½ *billion* in capital investment *today* to create 1½ million new jobs. By 1980, it will take an investment of $52½ *billion.*

Where will that money come from?

The key to getting the money we need for expansion and improvement of our plants is better earnings* —earnings that can be invested in our operations and that will encourage investors to provide us additional money.

But this alone is not enough because under present Federal tax laws the government would take too much of any additional dollars we can earn. What we need now is Federal tax reform to help lower barriers to capital formation.

*In 1975, Bethlehem's earnings after taxes were only 4.8% of revenues.



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How you can help gear up the American economy

The tax-writing committees of the U.S. Congress are studying the subject of "Capital Formation."

Here are four tax measures which we believe the Congress should enact to encourage industrial expansion and to create jobs: (1) five-year capital recovery system, (2) 12% permanent investment tax credit, (3) write-off of the costs of pollution control facilities in the year they are incurred, (4) eliminate the double taxation of corporate profits paid out as dividends.

If you agree that revisions in present Federal tax laws are needed to provide the additional capital for more and better jobs, we ask you to tell that to your Senators and Congressman.

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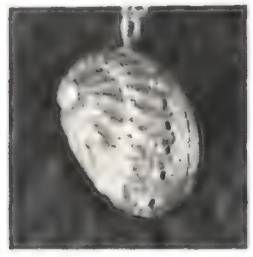

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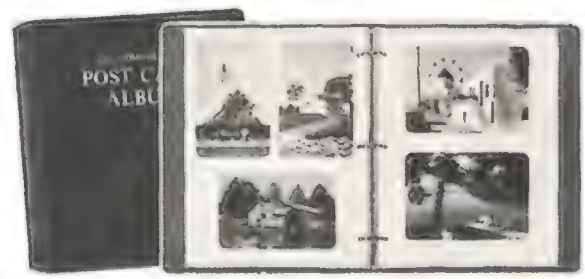

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affect one's life. Then an examination of the past can help determine the scope and rapidity of the cycle, and enable one to project the probable patterns of our own future.

GEORGE B. FIELD
Director, Smithsonian Astrophysical Observatory and Harvard College Observatory

In addition to the ever-present threat of nuclear warfare, we now face imminent and disastrous shortages of food, energy and raw materials on our spaceship Earth. Our primary goal during the last quarter of this century must therefore be to insure the survival of the human race and its civilization. One great hope for our future lies in the continued development of the international space-science program, which provides the best way to survey and plan for our limited Earth resources, and in which all nations may work to build that global view of our condition so essential to our survival. The profoundly human character of space research and exploration is brilliantly conveyed by the recent NASA retrospective, *Apollo Expeditions to the Moon,* edited by E. M. Cortright. Penetrating insights into the energy problems of this and coming decades are given by A. B. Lovins and J. H. Price in *Non-nuclear Futures: The Case for an Ethical Energy Strategy,* and by E. F. Schumacher in *Small is Beautiful: Economics As If People Mattered.* Finally, the broader search for an understanding of the universe, and of our place in it, is well illustrated in H. Friedman's beautiful new book, *The Amazing Universe.* All of these will repay a reading by those who share the concern of scientists everywhere about our future on Earth.

CLARENCE M. KELLEY
Director
Federal Bureau of Investigation

In his book, *Thinking About Crime,* James Q. Wilson of Harvard University examines with rare perception one of the most perplexing concerns facing our country today. He boldly acknowledges that "wicked people exist," and then proceeds to speak convincingly in behalf of the vast majority of law-abiding citi-

How to tell original prints from cheap reproductions.

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Kaiko Moti's original etching, "Oriental Owl", limited edition of 120.

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A few pointers, then, about original prints:

Original prints, whatever the process used to create them, are "hand-pulled" under the artist's supervision, or by the artist himself. This means that any work produced photographically or by another purely mechanical process is not an original print.

If you examine a print under a magnifying glass and discover a regular pattern of small dots, you will know immediately that it is not an original work.

Has the work been "hand-pulled"?

If the print is a serigraph (produced by a silk-screen process), the ink will seem rather like paint and appear to be sitting upon (rather than absorbed into) the paper.

Etchings and engravings will produce a physical impression on the paper itself.

Contemporary original prints will always be signed in pencil by the artist himself, to indicate personal supervision and approval of the individual print.

Original prints are always produced in limited editions, at the most several hundred copies. If thousands of copies are available, then the work is almost certainly *not* original. (In most cases, to assure that the integrity of their work is not violated, artists will destroy the plate after the edition has been produced.)

The print will have a figure on its border, indicating the number of prints pulled and the number of the individual print in the sequence.

Bernard Gantner's original lithograph, "Country Church", limited edition of 150.

For example, the figure 50/100 means that the edition has been limited to 100, and that this is the 50th print pulled.

There's a lot more to be learned about buying original prints, more than we can tell you on this page.

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Andre Brasilier's original lithograph, "Yellow Morning", limited edition of 175.

Is the edition limited and is the print numbered?

Did the artist personally sign the individual work?

Paul Guiramand's original lithograph, "Summer Fantasy", limited edition of 175.

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Dear Editor:

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By way of introduction, my name is Joe Gunterman, and I spent more than thirty-three years in the Cabin Service Department of UNITED AIRLINE. As manager of Cabin Service Planning I devoted much time and energy to the problem of keeping cabin interiors clean and fresh. Every method known to man was tested and it is my opinion that the Argo Method is the quickest, safest, and least expensive method available in terms of both materials and manpower to cover the tracks of over thirty million passengers per year.

Steam, as you pointed out, can be tricky. It soaks the carpet, generating a drying problem and can lead to shrinkage and in some cases mold.

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The Argo method is currently being used by Delta, United, PanAm, TWA, etc. In the case of United, I know that this product passed all of their most stringent engineering tests.

Joe Gunterman, 3 Bothwell, Palatine, IL 60067 (312) 359-0900.

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ANNIE DILLARD
Author, Pilgrim at Tinker Creek

My field is, I'm afraid, the whole shebang: the creation of the universe in the first place, prayer and incarnation, art in its relationship to eternity, eternity in its relationship to time. While there is an Earth, what happens on its surface in any century is mere gossip, so long as these other relationships obtain. God will keep creating and artists will keep making.

So the question is, what book best defines the relationship between time and eternity? Which brings us abruptly to the Bible, and sighs all around. But since I like a spoonful of sugar with my metaphysics as much as the next fellow, and since I believe that formal art is, because it partakes of this relationship itself and uniquely, best qualified to treat of such subtleties, the choice, limited to books, becomes one of value within literature. Which brings us, *pace* Shakespeare, to *Moby-Dick.*

JULIAN BOND
State Senator, Georgia

May I choose two? They are *Let Us Now Praise Famous Men* by James Agee and Walker Evans, and *Invisible Man* by Ralph Ellison.

These two—fact and fiction about people having the same roots—tell more about the experience of America's underclass than any other written works I know of.

SIM VAN DER RYN
State Architect of California

It's hard to single out a single "most significant book." The writings I come back to most often are the I-Ching, and also

FBI agents writing poetry.

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When was the last time you read something you couldn't wait to tell your friends?

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The National Observer goes behind the obvious headlines to dig out stories that make the world more interesting when you read them...and make *you* more interesting when you re-tell them.

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For instance, do your friends know that the Romans invented the frisbee? That we have *"two"* brains in our head? That tacos aren't just hot—they've also got the hottest sales?

And do they know about the controversial new gun that shoots "electric shocks"? And the "outdated" form of transportation that is coming back? And the place in America where voodoo is still practiced?

(The answers are: The taser. The blimp. And Oyo-Tunji, South Carolina—where it seems to *work!*)

The National Observer is written this way because we believe in the kind of journalism that says: "Talk to the reader one-to-one. Tell a story as if the reader were sitting next to you."

We bring you the out-of-the-ordinary.

When we report sports, we go beyond baseball, basketball and football...and tell about Shirley "Cha-Cha" Muldowney, the only woman ever licensed to race a top fuel dragster.

When we look at the world, we go beyond today's news to spot the trends that may make *tomorrow's* news...like how Italy's Reds (of all people!) are trying to make capitalism work.

Plus sometimes, after other newspapers think a story is over, we take a second look...at why the tourists *didn't* come to Mother Seton's hometown.

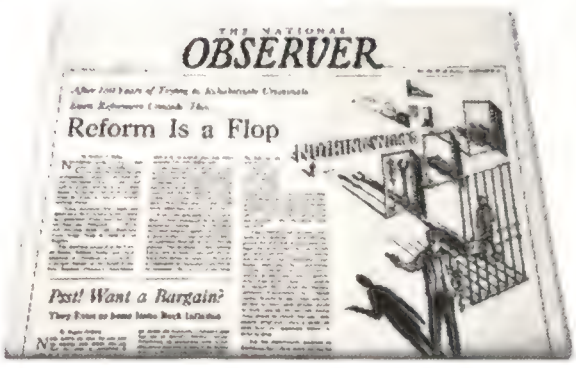
Regular sections with irregular news.

One nice thing about reading The National Observer week after week is our regular sections. But you can never count on what's going to be *in* them.

For instance, in the "Your Consuming Interests" section, we explored how conventional rubdowns survive despite the growth of sex parlors.

In our "Lively Landscape" section, you can read about the furor in Charleston, S.C. when the city council ordered horses to wear diapers.

You'll find surprises to share in every issue of The National Observer.



And our "Off-Hours" section reports on a lady welder who also finds time to paint, sculpt, write a novel and plant fruit trees.

We love a good zany story, like the one about the dog named Buckypoo who sings to piano.

We're full of new shopping buys, book and movie reviews, and "how-to's" on everything from better health to tomato jam.

And, in everything we do, we get our readers so *involved,* they write back.

Our "Letters to the Editor" section is one of our biggest—and liveliest. (We take it seriously. We once devoted the whole front page to reader gripes.)

And we even run reader plebiscites on major issues.

That's what person-to-person journalism does: We try to find things that will make our readers rush out to tell their friends. And they rush back with things they can't wait to tell *us!*

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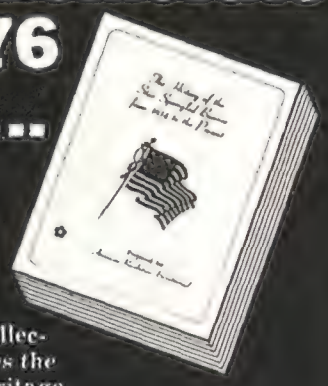

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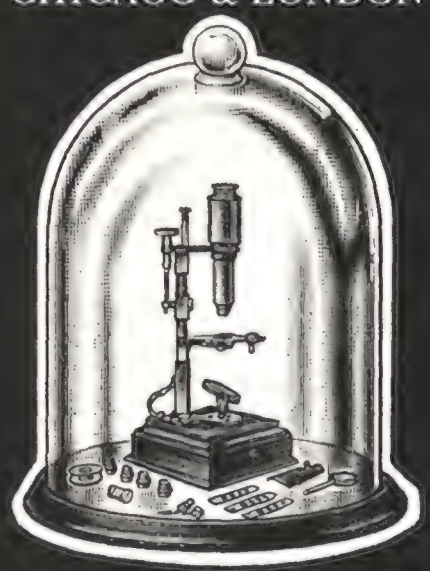

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Lao-tse. I can think of many people whose work and writings have helped shape my thought these last ten years, among them Thoreau, Gandhi, Rachel Carson, Laurens van der Post.

There are too many places to find information, too few to find wisdom. Ishi, Kroeber's Last Yurok, is supposed to have said about modern Man that "he is smart, but not wise." The Taoist texts provide me with the best understanding on how to live in relation to myself, other people, everyday and cosmic events.

CHARLOTTE KOHLER
Former editor, Virginia Quarterly Review

The book I recommend is *The Children of Pride,* that tremendous collection of family letters and journals so perceptively winnowed and edited by Robert Manson Myers. The 1,200 letters here, selected from more than 6,000 which were held on to when nothing else was saved, reveal a Southern family and their way of life during the years preceding, during and following the Civil War. The Jones family has lessons to teach this century through the revelation of their close-knit yet critical solidarity, their courage, their intense feeling for preserving their records, their ability (even of the most scatterbrained) to catch the substance and meaning—and color—of their lives and surroundings.

Readers might see some qualities of this life of the past that might prove useful in the future—endurance, compassion, understanding, a compulsion to preserve the records of their lives.

MORRIS K. UDALL
Member of Congress, Arizona

The Best and The Brightest by David Halberstam is a doubly important book because it tells where we have been as a nation, and reveals, I think, the reasons why we'll not make the same mistakes in the next quarter-century that we made in the past.

The Vietnam war alienated a generation from its leaders and contributed to the gross misuse of power by former President Richard M. Nixon.

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Halberstam's book reveals the blueprint of the process that led us to a most lamentable period of our history. We as a nation can ill afford to ignore or forget those revelations.

MICHAEL COLLINS
Director, National Air and Space Museum

One of my pet peeves is that Government Printing Office publications never seem to get reviewed. While the GPO puts out some very solidly researched material, it apparently is scorned by scholars and publishers alike as being just government propaganda. A recent victim of this attitude is a comprehensive report entitled *Outlook for Space* which certainly won't be seen by more than a handful of people outside government.

The product of a one-year study by 20 NASA experts, *Outlook for Space* speculates freely about the next 25 years. It is by no means a blueprint for the future, but rather a smorgasbord of choices. The volume is thick and the prose is stilted, but the facts are fascinating and make our options seem almost limitless.

As Margaret Mead told the Study Group, "We are at a point in history where a proper attention to space . . . may be absolutely crucial in bringing this world together."

IRA RUBINOFF
Director, Smithsonian Tropical Research Institute

In 1958 Charles E. Elton published *The Ecology of Invasions by Animals and Plants.* This book remains the most comprehensive analysis of ecological population explosions or epidemics of organisms which either inadvertently or quite deliberately have been introduced into new areas.

Many organisms that establish themselves in new places can become problems. For example, after World War I the influenza epidemic was reputed to have killed over 100 million people and at the beginning of this century an introduced fungus killed the chestnut trees in the Eastern United States. Such plagues are still very much with us, as witnessed by the current vaccination program designed to prevent an epidemic of swine

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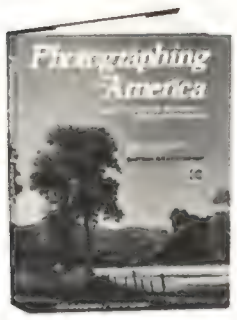

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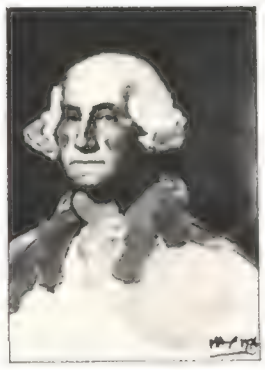

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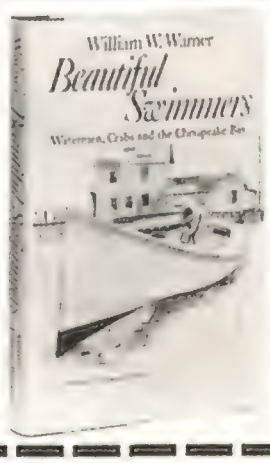

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The Court

A companion dining room to the Commons

The lofty-ceilinged Commons, opening off the Great Hall of the Smithsonian castle, has been called one of the stateliest dining rooms in Washington. For the thousands of Associates who have lunched there, the place and its buffet have provided a delightful experience, and food critics have praised its cuisine. (The Commons is temporarily closed for repairs.)

Now Associates have a second splendid restaurant —open for dinner as well as luncheon—across the Mall in the lovely new West Court of the Natural History Building. Called Associates' Court and, like the Commons, open exclusively for members and staff, it accommodates 250 Associates at a seating, or 700 for the luncheon or dinner hours, more than double the capacity of the Commons.

The Court, where reservations are not necessary, serves luncheon from 11 A.M. to 3:30 P.M., and dinner (through Labor Day) from 4:30 to 8 P.M. The Commons continues to serve luncheon from 11:15 A.M. to 2:15 P.M. Beer and wines may be bought at both restaurants and, at both, the ample buffet menu is changed daily.

The architect who designed the Court is Nathaniel Becker, and this is how he describes the setting of the new facility:

"The foyer and Associates lounge at the entrance to The Court is carpeted in a primitive figurative pattern. Wall displays of museum pieces make the walls of the waiting lounge both interesting and beautiful.

"The dining room itself is decorated in soft earth tones with comfortably cushioned spindle-back arm chairs, oak tables and natural linen yarn wall coverings. The mood of the room is enhanced by a sixty-foot glass mural of swirling autumn leaves."

Associates' Court is most easily reached by entering the Natural History Museum from Constitution Avenue, and is located at the right of the Baird Auditorium. Its convenient site gives Associates the opportunity to enjoy lunch and dinner on the Mall within easy walking distance of Washington's shops and theaters. You're invited to try it.

For further information about the operation and administration of the Court and the Commons, write to the Business Management Office, S.I. Building, 1000 Jefferson Drive S.W., Washington, D.C. 20560.

influenza. Everyone concerned with environmental quality must be aware of the possible untoward effects of introducing exotic species, and Elton's book is the source I recommend.

ELDRIDGE CLEAVER
Author, recently returned exile

I think that *Against Our Will* by Susan Brownmiller breaks new ground on the most important subject/problem confronting humanity, for nothing is more important than the vital connection between the sexes. *Against Our Will* is the book which I chose to bring with me when I surrendered to the U.S. Government, which I have had with me ever since, even now here in the Alameda County Jail. I think it is important that we focus on the fundamental problem, otherwise it remains unsolved.

What we need is a modern replacement for The Chase, one acceptable to both male and female. That is a tall order. It requires a new definition of human nature. Never mind waiting for a great philosopher to arise from amongst us and hand us down a new set of laws. We can take a giant step by understanding Susan Brownmiller's analysis of rape. She forces us to dig, to root, because her book is a bag of snakes tossed into a smoke-filled room. I commend her for accomplishing that, and for arming women with a powerful weapon. Rape will never be the same again.

ALVIN M. JOSEPHY JR.
Editor, American Heritage

Perhaps the biggest issue facing Man now and in the foreseeable future is survival—a question that will depend on how well and how soon Man learns to live in harmony with the life-sustaining forces of nature.

The literature of warning is large, but because it is a lucid, blunt and encompassing introduction to the alternatives we face, *The Closing Circle* by Barry Commoner is about as significant a book as any I can think of for an understanding of the next quarter-century.

DAVID CHALLINOR
Assistant Secretary for Science
Smithsonian Institution

I feel we are living in the most exciting period in the history of humankind. The virtual certainty that many scientific secrets will soon be unlocked is supported by the quality of current basic research. Only a few laymen are ever exposed to why and how such research will affect their lives, and especially their children's. I recommend *The Greatest Adventure: Basic Research that Shapes our Lives,* compiled by editors Eugene H. Kone and Helene J. Jordan. This well-edited volume consists of 16 short articles describing the research of as many distinguished scientists and how their work might influence the future of humanity. Our life to come rests in large measure on the quality of our basic research, but the available institutions, such as the Smithsonian, are few, not well understood and poorly funded. This book will go a long way in opening the eyes of the curious layman and should be read by anyone concerned about where we are going.

Smithsonian Institution Offers Commemorative Aviation Relic

CURTISS NC-4

Commanding Officer: LCDR Albert C. Read, USN
Pilots: Lt. Elmer F. Stone, USCG and Lt. (j.g.) Walter Hinton, USN
Crew: Lt. James L. Breese, USN; Ens. Herbert C. Rodd, USN; and Eugene S. Rhoads, USN

Original Fabric

The Curtiss NC-4 was the first airplane to complete a trans-Atlantic flight. On May 27, 1919, the flying boat set down on the water of the Tagus River in Lisbon, Portugal. The 4,000-mile flight from Rockaway Beach, New York, had been accomplished in nineteen days. The NC-4 is part of the collection of the National Air and Space Museum and is currently on loan to the Naval Aviation Museum, Pensacola, Florida.

The Curtiss NC-4, the aircraft that made the first trans-Atlantic flight in 1919, has been completely restored by the National Air and Space Museum. The historic original fabric, which was replaced during the restoration, is now available to the public. The best portions of the fabric have been cut into squares and mounted on handsome 15 x 20" posters.

The Curtiss NC-4 poster, the third of the Aviation Relic Series, will make a unique gift. Worthy of framing, this piece of history is a collector's item.

Information regarding the first two posters in this series, the Douglas World Cruiser and the Fokker D-VII, may be obtained by writing to the address below.

CURTISS NC-4
NATIONAL AIR AND SPACE MUSEUM
SMITHSONIAN INSTITUTION, WASHINGTON, D. C. 20560

Please send me _____ Curtiss NC-4 poster(s) at $12.00 each.
Enclosed is my ☐ check; ☐ money order in the amount of _____.
Please use U.S. Currency and add $1.00 for delivery outside continental United States.

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STREET _____

CITY _____ STATE _____ ZIP _____

Additional reading

American spirit (p. 28)

A City on the River by Roderick MacLeish, E. P. Dutton & Company, Inc., 1973

The Education of Henry Adams by Henry Adams, Houghton Mifflin Company (paperback), 1973

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Economics (p. 34)

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Appropriate technology (p. 42)

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Conservation for Survival by Kai Curry-Lindahl, Victor Gollancz Ltd. (London), 1972

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of Concerned Scientists, The MIT Press, 1975

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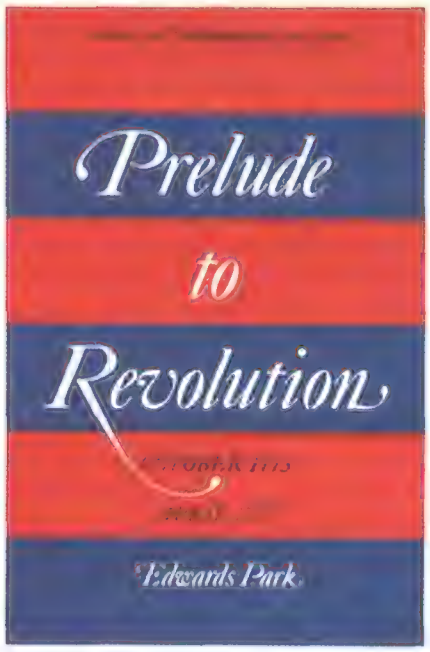

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Travel Benefits for Smithsonian Associates

With the growth of the Smithsonian Associates, the Institution is striving to meet the needs of its membership by offering a varied travel program. Traditionally, Foreign Study Tours provided culturally oriented, first-class, specialized trips under the guidance of museum curators or experts in respective fields. Then, Domestic Study Tours were added to offer similar opportunities within the United States, thus allowing Associates and their families a chance to combine vacation with a period of study. A year ago, Foreign Charter Tours were introduced; these trips are larger, lower-cost and more generalized in nature. Associates travel benefits are announced exclusively in SMITHSONIAN. Write addresses below for additional information.

Foreign Charter Tours

Great Britain*—September 2-16 or 16-30: The National Gallery, Tate, Victoria and Albert; walking tours of literary London and excursions in the countryside; the best of London theaters • **Eastern Europe***—September 23-October 7: Hungary and Czechoslovakia; "life-seeing" tours and museum seminars in Budapest; trips to Lake Balaton and Eger. Travel on the Danube by hydrofoil to Bratislava; five-day study and cultural program in Prague • Low cost of tours includes first-class hotels, most meals, sightseeing, lectures, theater tickets and round-trip air fare from Washington, D.C. Watch for the announcement of the 1977 charter program. Foreign Charter Tours are heavily subscribed, so write early for reservations and additional details concerning a specific trip to Smithsonian Associates Travel Program, A & I 1270B, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5636 for information. *Optional predeparture courses will be offered.

Domestic Study Tours

Wind River Mountains—July 31-August 8: The mountain meadows of Wyoming offer a special wilderness experience with emphasis on the sub-alpine flora • **Williamsburg for Families**—August 13-15: A special program for children ages 6 through 14 (and their parents) to learn of the 18th-century life by experimenting with colonial crafts • **Massachusetts Heritage**—August 15-23: Visit Salem, Deerfield, Old Sturbridge Village to learn about early American antiques, decorative arts, and architecture. Also the Boston Symphony at Tanglewood • **Desolation and Gray Canyons**—September 3-13 and October 8-18: A white-water trip for the adventurous; explore the geology, wildlife, Indian and outlaw history of Utah's Green River • **Pacific Northwest**—September 7-18: A tour of Olympic Peninsula and Cascades to learn more about use of our forest resources • **Hirshhorn Sculpture Weekend**—September 17-19: In-depth tour of an extensive collection of modern sculpture. • **Coastal Maine and New Hampshire**—September 25-October 3: A nature tour of Acadia National Park and White Mountains during the peak of foliage color • **California Wine Country**—October 3-9: Learn about California wines with lectures and wine tasting at selected vineyards in Napa, Sonoma, Santa Clara and Monterey • **Archaeological Field School**—October 9-16: Join archaeologists in the excavation of an Illinois village ruin dating to the Mississippian Period (A.D. 900-1400) • **Colonial Williamsburg**—October 24-28: A program planned for adults to learn about life in 18th-century Virginia through tours and special lectures. • **Philadelphia Art & Architecture**—November 3-7: Emphasis on the Pennsylvania Academy of Arts and Bicentennial art exhibit, reopening of Philadelphia Museum of Art • **Gem Mines Field Trip**—November 4-9: Join gem experts in the field study of western North Carolina gem mines • **NASM Weekend**—November 12-14: Special program with staff to see and learn about new Air & Space Museum • **Tropical Greenery of Puerto Rico**—November 28-December 8 • **Washington "Anytime" Weekend**—Visit the nation's capital and tour the original Smithsonian building. Spend two nights at Loew's L'Enfant Plaza Hotel (reservations required ten days prior to weekend) • Write Associates Travel Program, A & I 1270B, Smithsonian Institution, Washington, D.C. 20560 for reservations or call (202) 381-5635 for information.

Foreign Study Tours

Venice Restored*—September 16-30: Dr. David Alan Brown and Anne Radice, both of the National Gallery of Art, explore art and life of Venice • **Morocco and Egypt**—September 26-October 19: Temples, palaces, souks and archaeological sites • **Adriatic Shores**—October 2-17: Art, architecture and archaeology. Cruising aboard the yacht *Argonaut*, visit cathedrals, palaces and museums on both coasts of the Adriatic. Sail from Athens through the Greek islands, calling at eastern Italian cities up to Renaissance Venice, then sail down the Dalmatian Coast of Yugoslavia with calls at Split, Dubrovnik and Kotor, returning to Athens • Write Miss Bliss Schumann, Foreign Study Tours, SI 123, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5520. *Optional predeparture lectures will be offered.

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SPORT AND PLAY IN THE AQUA CULTURE ROOM. STRICT POPULATION CONTROLS LIMIT THE FAMILY UNIT TO 2.4 CHILDREN; WALTER, THE ELDEST, IS A PROFESSIONAL PART-TIME CHILD WHO MAKES UP THE FOUR TENTHS DISCREPANCY. THE YOUNGER CHILDREN RIDE THE GENTLE-EYED RATCOW, A GENETIC CONSTRUCTION COMBINING THE HARDY TRAITS OF THE WHARF RAT WITH THE USEFULNESS OF THE HOLSTEIN. SHE BROWSES AND TRIMS THE HYDROPONIC CARPET OF BEAN-SPROUTS AND GIVES MILK FROM THE FORWARD UDDER (OR, GENETICALLY MANIPULATED, YOGHURT) AND VALUABLE METHANE FROM THE AFT UDDER. SEVERAL STRAINS OF NUDE SHELLFISH HANG IN THE HYDROPOND; GENETICALLY STRIPPED OF THEIR NEED FOR PROTECTION, THEY INHABIT THE RECYCLED SHELLS OF OUTMODED SPECIES.

Whimsical future steps in ecoliving

Solar heaters, wind generators and methane digesters will take us only so far. What is needed is a basic redesign of everything

THE FAN-BUZZARD: ENGINEERED WITHOUT THE ABILITY TO FLY BUT CHARGED WITH THE FIERCE DESIRE TO DO SO; CIRCULATES AIR.
THE VENUS FLY-TOMATO; EATS INSECTS OR TABLE SCRAPS THROWN AT WALL.
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A DOMESTIC SCENE OF THE FUTURE. IN THE NEW SOCIETY OF LEISURE, ALL TURN TO PHOTOGRAPHY AND POTTING. SOON BECOMING BORED WITH SNAPS OF THE SAME FACES, ALL TURN TO POTTERY. POTS ARE THROWN FROM AN EDIBLE CLAY MADE OF LEAF DETRITUS, AND THE INCONVENIENT OVER-SUPPLY IS THROWN TO THE FIERCELY PROTECTIVE GERMAN WATCH-ROACH.
A BEMUSED AUTHOR, WITH A GARÇON RODWORM PENCIL IN HAND, SITS IN THE EFFICIENT RATCHET-ROCKER (WHICH STORES MECHANICAL ENERGY) COOING TO A FAVORITE RAGEON. ALMOST HIDDEN IN THE FOLIAGE OF THE FRENCH-INTENSIVE-AGRICULTURAL WALL TO THE LEFT IS THE SKINNERIAN DYNAMO: RAGEONS ARE TRAINED TO RECEIVE FOOD (POT SHARDS) BY PECKING PIEZO-ELECTRIC CRYSTALS.

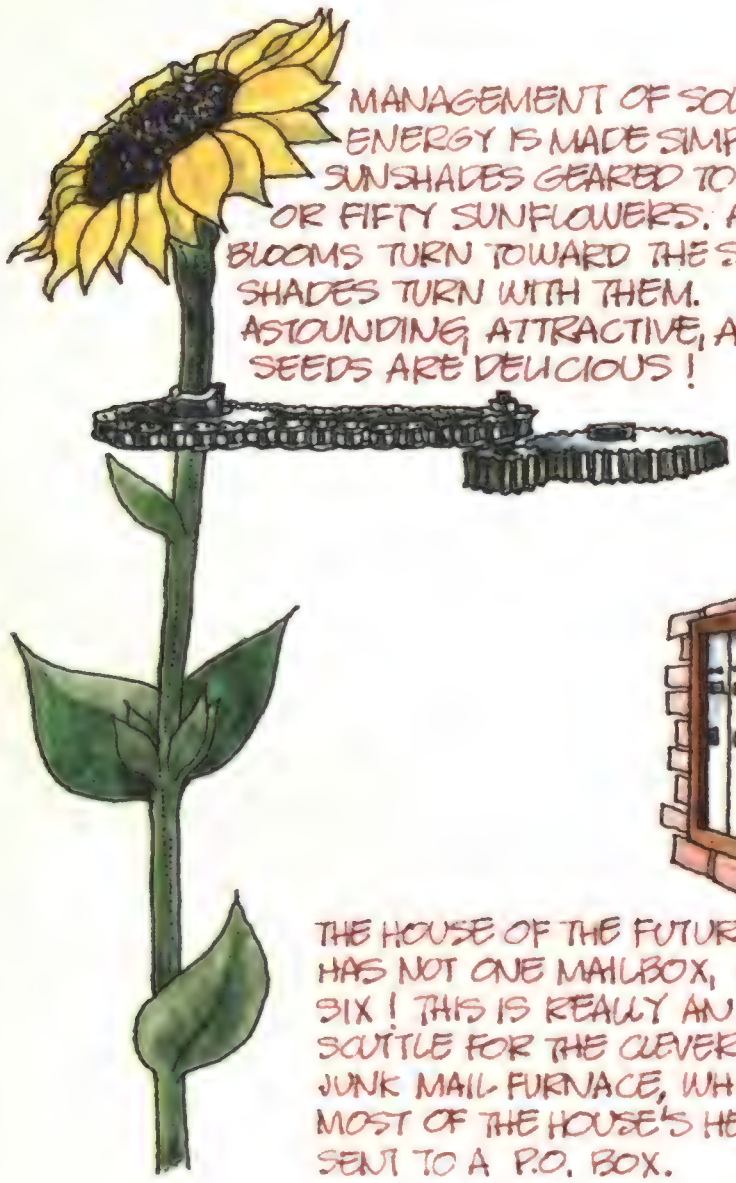
Tomorrow is here! It arrived yesterday when results of the Prometheus Study were leaked to the press by the project information officer. Jointly funded by the Interior, Housing and Urban Development, Health, Education and Welfare, and Agriculture Departments, it points the way to surviving tomorrow and tomorrow and tomorrow's petty pace which will soon be roused to a quickstep by the technologies of genetic engineering, alternative energy, human resources management and transcendental meditation. Pictured here are some of the high points of that study.

The beginnings of genetic tinkering are part of our history. The respected journal of science, *Demonic Physics and Zodiacal Gardening*, notes that such short-lived creatures as the griffin, the unicorn, the manticore, the sphinx and the once ubiquitous dragon were the botched genetic splices of a fifth-rate band of prehistoric star-travelers.

An early warning of difficulty to come was the energy-intensive struggle Daedalus experienced in keeping the gene-fumbled Minotaur fed, housed and away from decent folk. The Jewish folklore story of the Golem, a giant made out of clay, is a fine example of using abundant materials, albeit a bleak one. Some

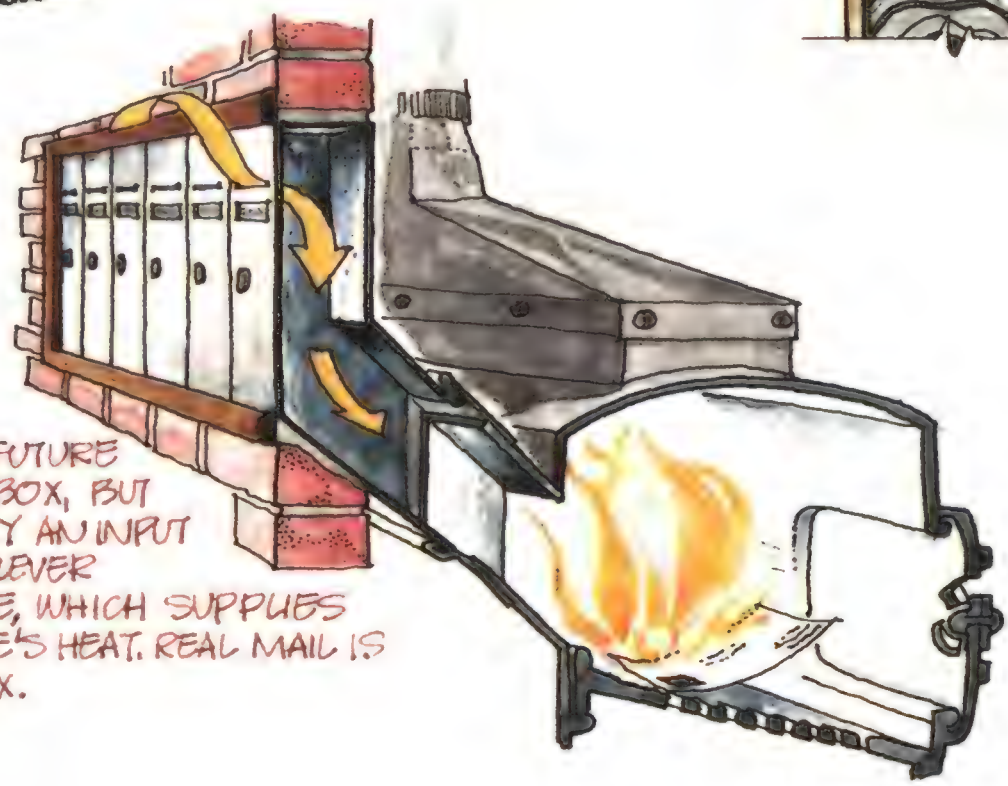
Text and illustrations by Jan Adkins

TECHNICAL ADVANCEMENT MAKES THE HOUSE OF THE FUTURE NEARLY SELF-SUFFICIENT, IN ENERGY TERMS. THIS COUPLE IS SLEEPWORKING — SLUMBERING IN ENCLOSED VESSELS, ALLOWING THEIR BREATHING TO DRIVE BELLOWS AND STORE ENERGY. THE SLEEPWORKER BED HAS BEEN COMMENDED BY THE ZERO POPULATION GROWTH GROUP.



MANAGEMENT OF SOLAR ENERGY IS MADE SIMPLE WITH SUNSHADES GEARED TO FORTY OR FIFTY SUNFLOWERS. AS THE BLOOMS TURN TOWARD THE SUN, THE SHADES TURN WITH THEM. ASTOUNDING, ATTRACTIVE, AND THE SEEDS ARE DELICIOUS!

INSULATION IS IMPORTANT IN CONSERVING HEAT ENERGY. HERE IS A SECTION THROUGH THE EXTERIOR WALL OF A HOUSE INSULATED WITH BACK ISSUES OF *Mother Earth News*.



THE HOUSE OF THE FUTURE HAS NOT ONE MAILBOX, BUT SIX! THIS IS REALLY AN INPUT SCUTTLE FOR THE CLEVER JUNK MAIL FURNACE, WHICH SUPPLIES MOST OF THE HOUSE'S HEAT. REAL MAIL IS SENT TO A P.O. BOX.

researchers find in the notebooks of the great Leonardo directions for pharmaceutically altering gene structure (though other researchers interpret them as an early recipe for veal parmigiano).

It was in the 19th century that discoveries in electricity permitted the first real research into new lifestyles through altered genes. They were faltering steps, but important. A few disappointments, however, closed the doors on pure inquiry for some time ("There are things man dare not tamper with," said Dr. Victor Frankenstein) until the widespread use of drugs and radioactive material had revived interest in this ancient pursuit.

Today, advanced study has been made possible by knowledge of the structure of DNA, the electron microscope, lasers and good all-night delicatessens that will deliver. Dr. Eric Begat, director of the Lévi-Straus Gene Study Foundation, says, "We could make a

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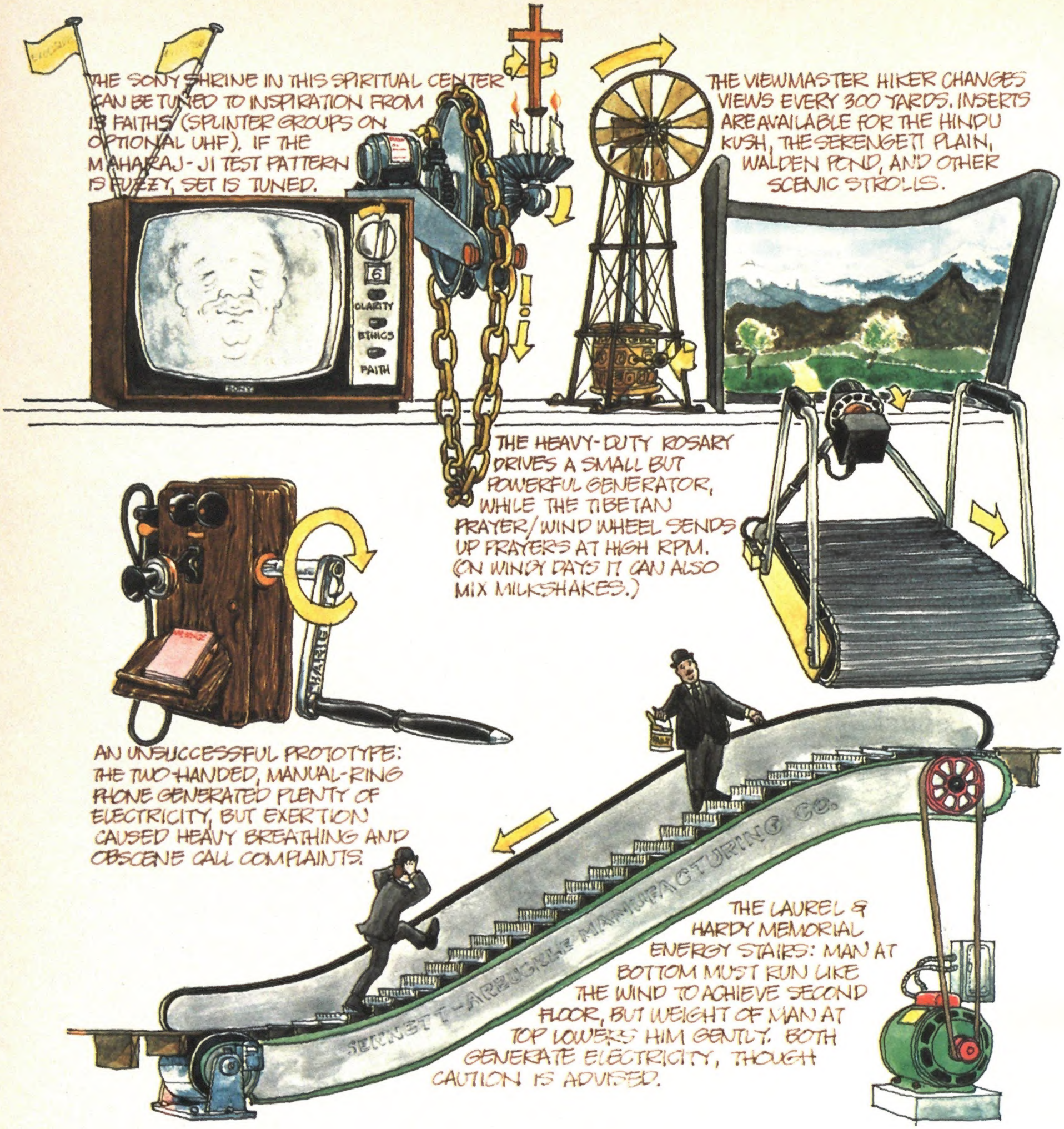
THE SONY SHRINE IN THIS SPIRITUAL CENTER CAN BE TUNED TO INSPIRATION FROM 13 FAITHS (SPLINTER GROUPS ON OPTIONAL UHF). IF THE MAHARAJ-JI TEST PATTERN IS FUZZY, SET IS TUNED.
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ETHICS
FAITH
THE VIEWMASTER HIKER CHANGES VIEWS EVERY 300 YARDS. INSERTS ARE AVAILABLE FOR THE HINDU KUSH, THE SERENGETI PLAIN, WALDEN POND, AND OTHER SCENIC STROLLS.
THE HEAVY-DUTY ROSARY DRIVES A SMALL BUT POWERFUL GENERATOR, WHILE THE TIBETAN PRAYER/WIND WHEEL SENDS UP PRAYERS AT HIGH RPM. (ON WINDY DAYS IT CAN ALSO MIX MILKSHAKES.)
AN UNSUCCESSFUL PROTOTYPE: THE TWO-HANDED, MANUAL-RING PHONE GENERATED PLENTY OF ELECTRICITY, BUT EXERTION CAUSED HEAVY BREATHING AND OBSCENE CALL COMPLAINTS.
SERENGETI-ARBUCKLE MANUFACTURING CO.
THE LAUREL & HARDY MEMORIAL ENERGY STAIRS: MAN AT BOTTOM MUST RUN LIKE THE WIND TO ACHIEVE SECOND FLOOR, BUT WEIGHT OF MAN AT TOP LOWERS HIM GENTLY. BOTH GENERATE ELECTRICITY, THOUGH CAUTION IS ADVISED.

griffin any time we want to. We just don't want to."

In the foreseeable future, work beyond the simple animal, mineral and plant species pictured can lift personkind into a broad, sunlit upland of hope and, well, happiness. Imagine a being genetically tuned so that he could not forget his gloves in a phone booth, think of a race of superheroes exactly like Mark Spitz, dream of the time when no one will have earwax.

New frontiers await, and we must be ready. Technology is gearing up for the last push. The watchword has to be "science got us into this, and science can get us out!" *Homo erectus, Homo sapiens,* and at last *Homo westinghouse.*

The future is coming, bright and shining. I hope it is just dandy. As for me, I'm sitting this one out. I'm sending my clone.

A great dinner, cont'd.

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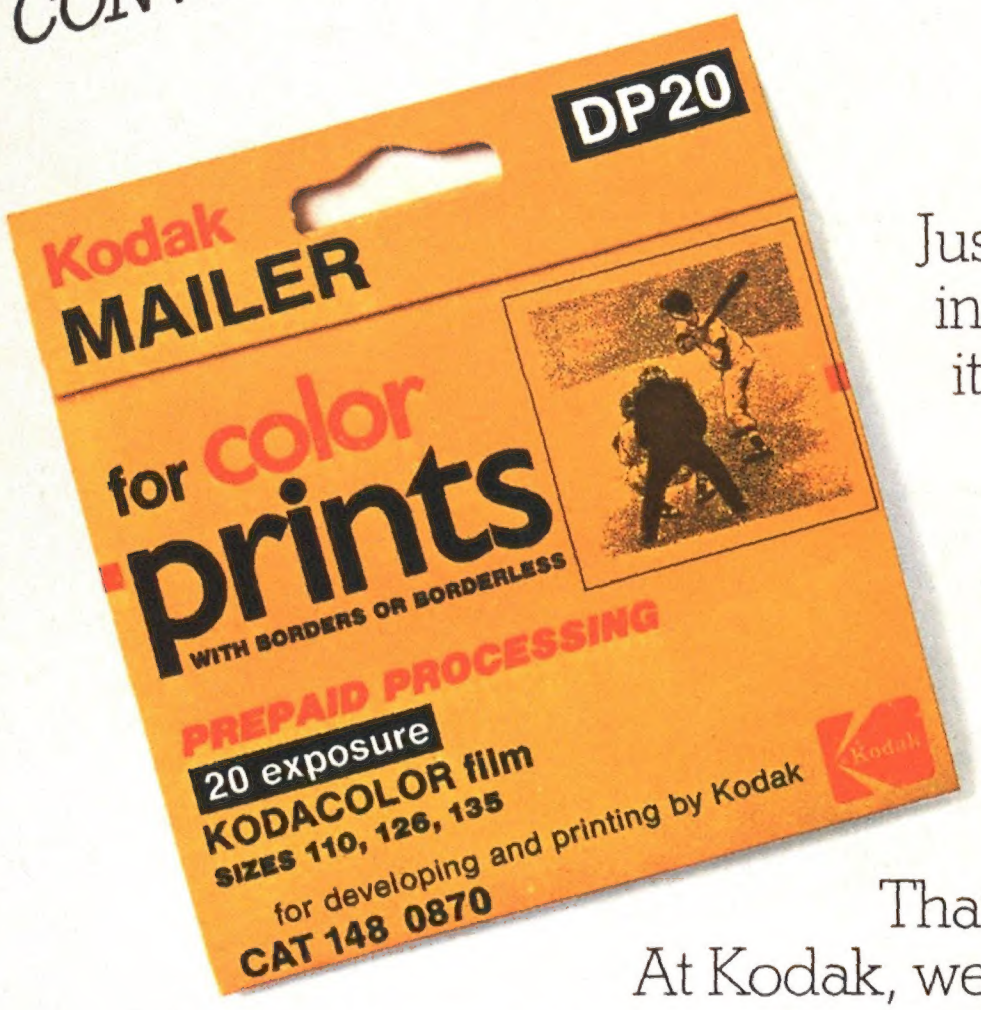

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